Industry Power

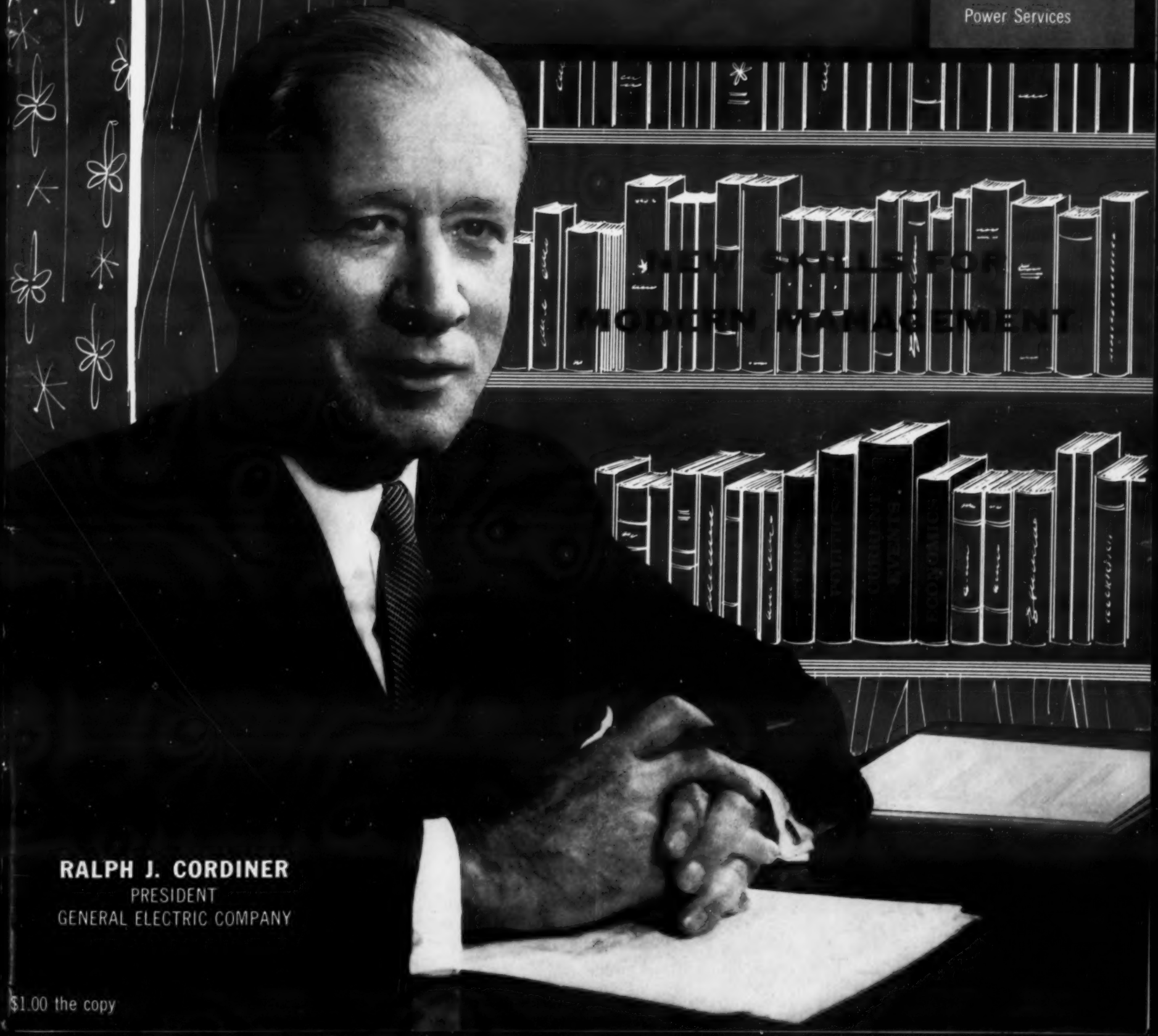
A Putman Publication — Executive Magazines for Industry

JUNE 1957

For Men Who Manage

Power Services

NEW SKILLS FOR MODERN MANAGEMENT



RALPH J. CORDINER
PRESIDENT
GENERAL ELECTRIC COMPANY

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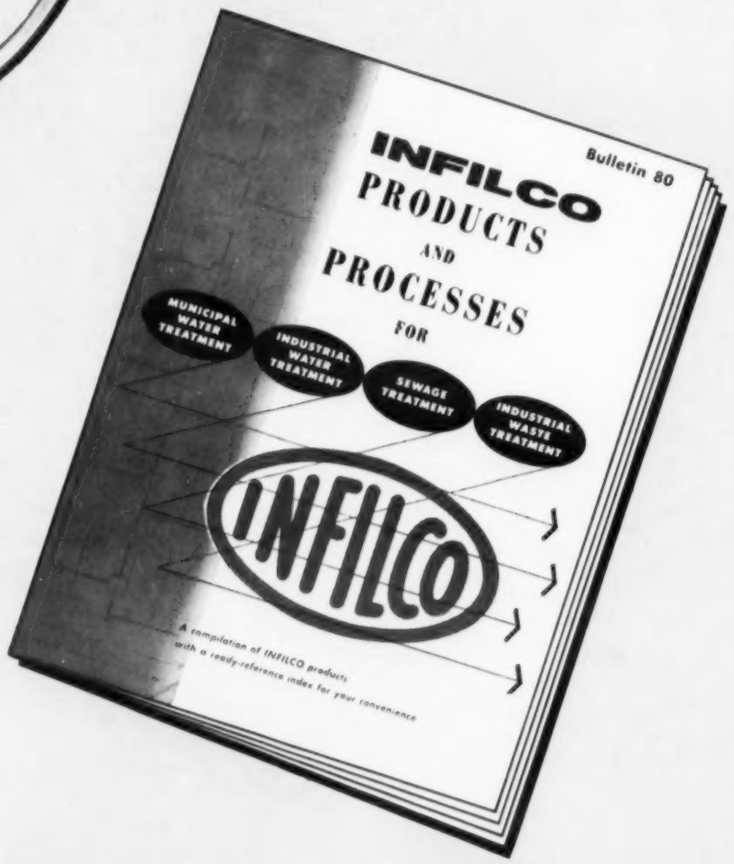

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←

that's interesting

. . . for industry power

Looking for typewriter dots?

A new metal detector developed by RCA is sensitive enough to pick out stray or tramp metal no larger than a typewriter dot. Detector uses specially designed coils producing high-frequency magnetic field to make continuous electronic inspection of product and production equipment in industry.

50,000 volts doesn't faze transformer of the future

Flashover of 60-cycle current at 50,000 volts under a

water spray doesn't damage molded plastic cover and bushing in this General Electric transformer of the future. Not yet for sale, units will be given extensive field test during 1957. Covers are molded from reinforced polyester resin.

Mechanical blackboard erases itself automatically

Operators of this mechanical blackboard (which can erase itself automatically) at University of Michigan's Research Institute, can find the best of 2 billion billion answers. Called MITAB, (for Michigan Transportation and Assignment Blackboard), the device isn't properly a computer. It can't remember instructions but can provide mathematical answers in 20 minutes that would take ordinary electric computers years to work out. ♦ ♦

SINCE 1888 ALCO Has Said: "Steam Supply by B&W"

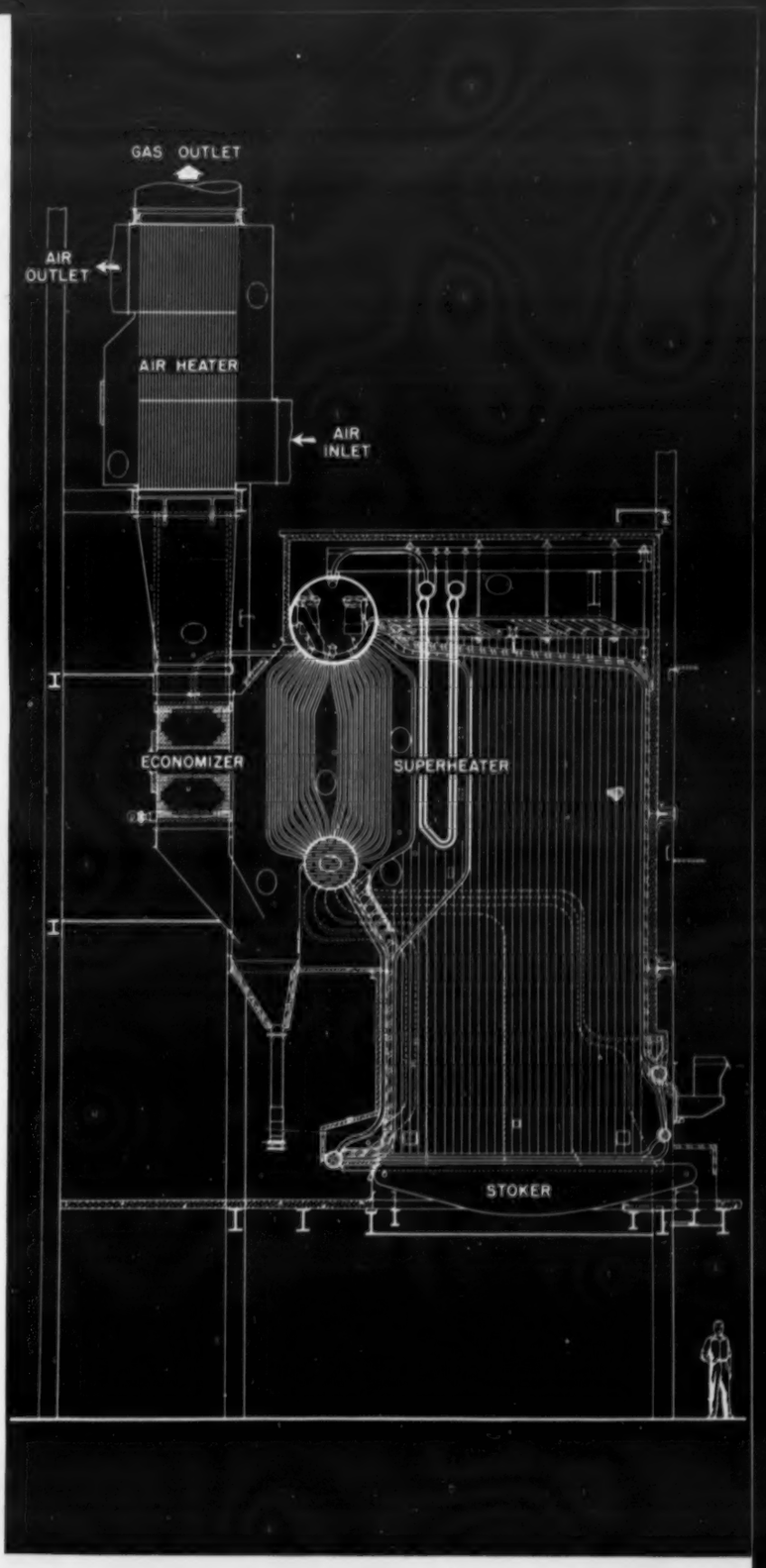
Back in 1888, when the *American Type* locomotive was setting speed records on passenger runs, B&W sold its first boiler to Schenectady Locomotive Works, predecessor of ALCO Products, Inc., to serve the plant.

In January 1955, two more B&W Two-Drum Stirling Boilers went on the line at the company's Schenectady plant. They are providing 100,000 lb of steam per hour for heating, for driving plant auxiliaries, and for some power generation. They bring the number to 40 B&W boilers in ALCO and its predecessors' plants.

What's Interesting about these two latest B&W boilers at ALCO is that they have operated at higher efficiencies than the design contract specified. To ALCO, with its long experience with B&W boilers, this was no surprise.

Long Range, Sustained economy—the product of the top level engineering design found in every B&W boiler—has become something to be expected by long time B&W customers.

More and more manufacturers, in the widest variety of lines, have learned, over the years, to depend upon B&W for an efficient, dependable source of steam. Whatever your steam needs may be—for heating, processing, or power generation—B&W engineers are ready to give you counsel, with nearly a century of steam generation experience behind them. The Babcock & Wilcox Company, Boiler Division, Dept. 1P-2 161 East 42nd St., New York 17, N. Y.



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Industry Power

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A PUTMAN PUBLICATION

Industry Power

FOR MEN WHO MANAGE POWER SERVICES

VOLUME 73 NO. 1 JUNE 1957

In this issue . . .

new skills are required for modern managers 13

Today's successful management, in avoiding pitfalls of obsolescence and conformity, must recognize and meet many challenges. GE's president outlines a forward-looking management philosophy.

package nuclear power plant 14

U. S. Army's first nuclear power plant (APPR-1) is prototype for the military services and possible forerunner of small industrial reactors. Now in operation at Fort Belvoir, reactor's estimated cost is $3.5 million.

get more for your services dollar 16

Power services engineers patrol utilities services in large refinery, saving thousands of dollars annually in utility costs. Organization and operation of Conservation division is described.

today's plant requires planned power system 18

Electric distribution system to meet present and future load requirements of office, manufacturing, and testing facilities were needed at new GE plant. Experts use standard equipment to accomplish this.

basic steam plant design 20

U. S. Navy's Bureau of Yards and Docks shows you how to save money when building or expanding boiler plants in 20,000 to 150,000 lb/hr capacity. Includes specifications for any type of firing.

monthly features . . .

that's interesting	3	news in photos	42
nuclear news	6	names make news	44
late news	8	handy guide	49
this month's comment	10	reprints available	52
new bulletins	24	advertising index	53
new products	26	the locator	53
basic bulletins	38		

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nuclear news

. . . about industry power

Argonne offers radiation-biology course

Argonne National Laboratory will give special course July 1-26 at Lemont, Ill., in Radiation Biology. Course is intended primarily for limited number with previous experience in biological research. It will stress general experimental theory and design. Dosimetry and instrumentation needed for bio-research with ionizing and low-energy radiations, and effect of these radiations on widely diverse biological systems, will also be included.

AEC sets up first phase of new reactor system

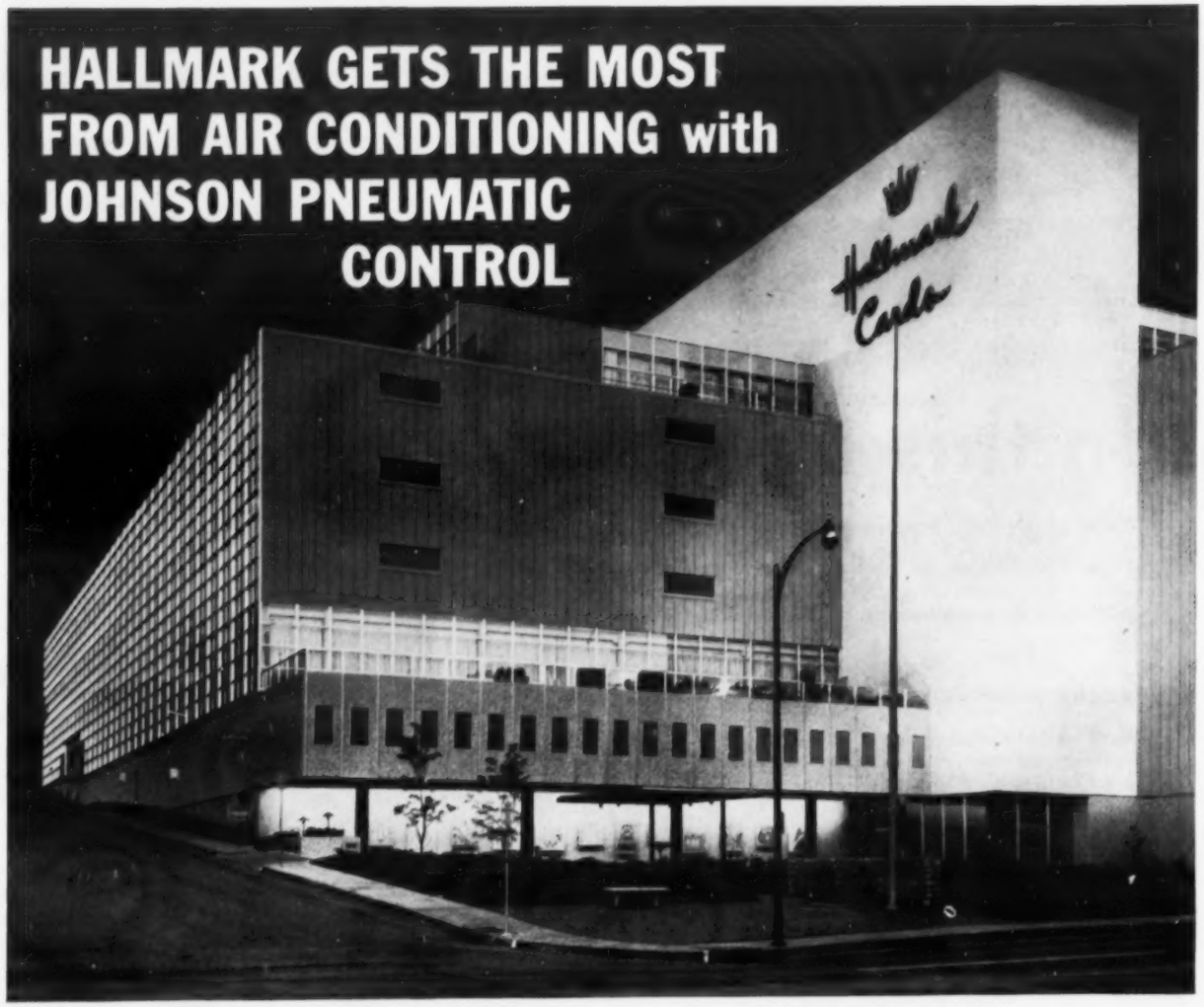
First phase of a three-phase program proposed for liquid-sodium cooled, heavy-water moderated reactor for 10,000-kw nuclear plant at Anchorage, Alaska, has been set up by AEC. Contract for research, development, and preliminary design of the new reactor has been awarded to Nuclear Development Corporation of America. Estimated cost of first phase is $1,725,000. Remaining phases will be instituted only if NDC's work demonstrates feasibility of combining heavy water as moderator and liquid sodium as coolant in reactor system.

Atomic industry will surpass all records in 1957

With 28 reactors completed and 59 new units started in 1956, U. S. atomic progress in 1957 will surpass record advance made in 1956. Harris, Upham and Company, nationwide investment brokerage house, predicts the nuclear industry is approaching the multi-billion dollar level.

U. S. industry can't afford atomic isolation

U.S. industry recognizes it cannot afford isolationism in world race to harness atoms for peace, says Vice Admiral George F. Hussey, Jr., managing director, American Standards Association. U. S. has been



Hallmark Cards, Inc., Kansas City, Missouri. Welton Becket & Associates, architects and engineers; Long Construction Co., general contractor; Interstate Heating & Plumbing Co., mechanical contractors; all of Kansas City.

Multi-Purpose Pneumatic Control System Helps Solve Diversified Production Problems, Insures Made-To-Order Working Climate

Precision regulation of temperatures and humidities makes important contributions to production efficiency in the new air conditioned home of Hallmark Cards. The "brainwork" for the air conditioning system is done by a Johnson Pneumatic Control System that matches temperature and humidity conditions to the exact needs of the work carried on in each room and area of the 760,000 sq. ft. building.

Effective control has simplified numerous problems of handling temperature- and humidity-sensitive paper stock and helps make possible consistent, high speed, quality production of famous Hallmark greeting cards.

Equally important is the provision of an ideally controlled environment for Hallmark's creative staff and office employees.

Proper control of industrial air conditioning, heating and ventilating systems is becoming increasingly important as a means of improving production, cutting costs and adding to worker efficiency. The specialist Johnson organization will welcome the opportunity to work with you, your staff engineer or consulting engineer in applying these advantages to your operations. Johnson Service Company, Milwaukee 1, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON CONTROL
PNEUMATIC SYSTEMS
PLANNING • MANUFACTURING • INSTALLING • SINCE 1885

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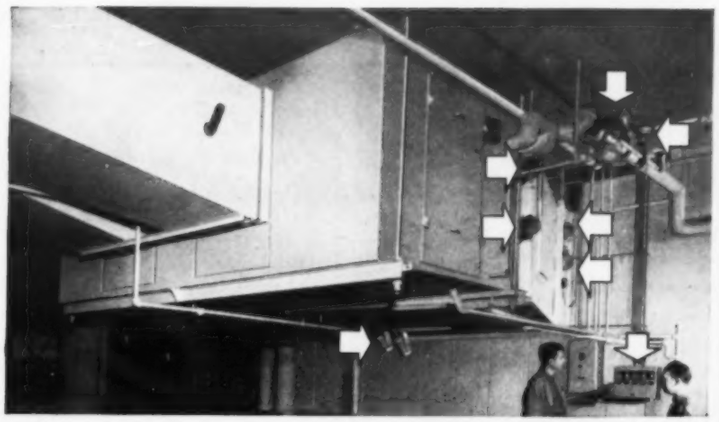

Conditioned air is supplied by 45 single-zone and 10 multi-zone units. Johnson equipment is shown above controlling outdoor air and return air dampers and hot and chilled water supplies on a typical production area unit. Space conditions are controlled by Room Thermostats and Room Humidostats.

Fast response to load shifts is a must in the 600-seat cafeteria. Sensitive Johnson Thermostats and Humidostats quickly compensate for changes in occupancy, hold temperature and humidity at ideal comfort levels. Stage and projection equipment permit the dining area to be used also for company functions.

Refreshing, perfectly regulated temperatures add to the efficiency of Hallmark's all-important creative staff. Many companies report that properly controlled air conditioning not only improves worker performance but helps reduce absenteeism and turnover and makes recruiting easier.

YOU CAN DO IT BETTER with JOHNSON PNEUMATIC CONTROL

1. Greater Simplicity—pneumatic control involves far fewer and much simpler components than anything else you can use.
2. Ease of Operation—inexpensive control pressure gauges, exclusive with pneumatic systems, give you unlimited freedom to observe and direct system operation.
3. Choice of Features—widest choice of operating features to match your needs. Johnson makes the most complete line of pneumatic temperature, humidity and pressure control equipment.
4. Less Upkeep—there are fewer components to check, fewer parts subject to failure.
5. Reliable Performance—Johnson Pneumatic Control is unaffected by short circuits, electrical overloads, voltage variations and humidity. You get continuous, accurate control.
6. Complete Safety—even in the presence of explosive gases, solvents, dusts and other hazardous materials.
7. Maximum Flexibility—a big "plus" value in industrial work. No matter how exacting your needs, Johnson Pneumatic Control can produce the results required. It can be applied to any type or make of air conditioning, heating or ventilating system. Each Johnson System is engineered and installed to suit the requirements of the individual installation.

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elected by International Organization for Standardization to lead world standardizing in nuclear energy for industrial use. Nuclear Standards board of ASA is responsible for U.S. program; supervises committee work in six major areas: general and administrative standards, nuclear instruments, chemical engineering in nuclear field, reactor hazards, radiation protection, and electrical requirements for nuclear reactors and atomic systems.

Ceramic pellets fuel nuclear reactor

New type fuel, ceramic pellets of urania-thoria, are being used for first time as fuel constituents for nuclear reactors. Scientists at Argonne National Laboratory say major reason for using ceramics as fuel elements is that they do not, like metallic fuel elements, grow and become distorted under intense radiation. Pellets are being used in Borax series experimental reactor at National Reactor Testing Station near Idaho Falls, Idaho.

Plan new nuclear facility

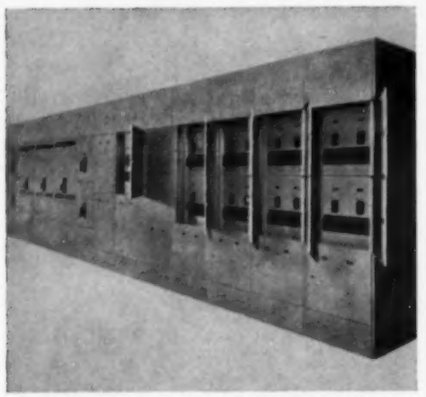
Sylvania-Corning Nuclear Corporation, new nuclear company recently set up by Sylvania Electric and Corning Glass Works, plans to build new plant at Hicksville, N. Y. Plant will produce atomic fuel elements for reactors used in research and electric power generation, says Dr. Lee L. Davenport, Sylvania-Corning's president. Plans call for completion of the project by late summer.

Unique monitoring system for Shippingport

Unique radiation monitoring system soon to be installed at Duquesne Light Co.'s nuclear plant near Shippingport, Pa., will prevent harmful radioactive material from entering atmosphere. Monitoring system, designed and built by X-Ray division of Westinghouse, will also check for leakage in reactor's water cooling system, contamination in plant ventilating and cooling air, also keep continuous radiation chart record in selected areas of this new plant. ♦ ♦

MOLDED CASE CIRCUIT BREAKERS

I-T-E plug-in mounted "Cordon" Circuit Breakers represent the maximum in flexibility, economy and safety.

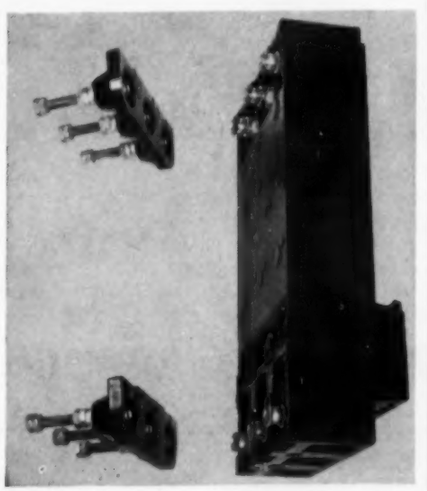


Typical switchboard installation of "Cordon" Circuit Breakers and large air circuit breakers.

I-T-E Plug-In Mounted "Cordon" Circuit Breakers Have Saved Countless Man-Hours

Plug-in mounting in switchboards provides features and advantages you get only in this modern, streamlined construction. Consider the ease of installation, the time saved in assembling switchboards. Consider the flexibility in meeting changing circuit conditions, the advantage of being able to change breakers without disturbing terminal connections. Consider, too, the added safety of concealed terminals with no live parts exposed. When you do, you'll specify switchboards with this time-proved method of installing molded case circuit breakers.

I-T-E plug-in molded case circuit breakers are available in ratings from 15 to 600 amp, up to 600 volts a-c, 250 volts d-c. Contact your I-T-E representative or leading independent switchboard manufacturers for details. Or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.



Used for many years in marine switchgear and approved by Underwriters' Laboratories Inc., I-T-E plug-in mounted circuit breakers require only two compact mounting blocks for switchboard installation.

I-T-E CIRCUIT BREAKER COMPANY

Small Air Circuit Breaker Division

In Canada, Eastern Power Devices Ltd.

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late news

. . . about industry power

• ASME forms new group

Headed by Guerard Mackey, Du Pont engineer, new group is formed by ASME to deal with engineering problems in maintenance. Group objective is to keep engineers up to date on new developments in field of maintenance and plant engineering. Program will include sponsoring technical papers to be presented at ASME national meetings. More than 200 ASME members have indicated interest in the group. Members of executive committee are: Robert H. Moore, Philadelphia Electric Co.; John K. Bryan, Union Electric Co.; Benjamin G. Evans, Eli Lilly Co.; and Arthur W. Weber, Corning Glass Works.

• Glen Canyon dam contract awarded

Contract to build the Glen Canyon dam on the Colorado River in Arizona has been awarded Merritt-Chapman-Scott, says Fred G. Aandahl, assistant secretary, Department of the Interior. The New York construction firm's bid was $107,955,522, largest single contract of record for a dam. Construction will take nearly seven years.

• Gas-turbine power plant logs 5000 hours in test

5000-kw railway mounted gas turbine power plant, designed and built by Westinghouse for U. S. Army Engineers, has logged well over 5000 hours operating time. Concluding a one-year test operation, the new power plant is now on standby basis at Army Engineering Depot, Marion, Ohio.

• Memphis buys Link-Belt system

Link-Belt Company has been awarded contract for coal-handling system at new 750,000-kw Thomas H. Allen plant for City of Memphis. Dual-belt coal conveyor system will convey coal from

barges to coal crushers and to storage, and from crushers or storage to bunkers. Initial capacity will be 2200 tons/hr. It will be largest coal-handling system ever installed as initial equipment. New Memphis station is outgrowth of controversy over Dixon-Yates plan for a similar electric generating facility.

- **H. K. Porter acquires electrical firm**

Second recent purchase by H. K. Porter Company of an electrical manufacturer, will put R. Thomas & Sons Company, makers of high-voltage electric porcelain, under Porter's Delta Star Division. Porter recently announced acquisition of Federal Wire and Cable Co., Ontario, Canada.

- **Japan becomes leader in power development**

Recent purchase of two 156, 250-kw turbogenerators by Japanese utility companies will put that country among the world's leaders in power development. Sale of the generators by Westinghouse will add over 2 billion kwh annually to southern Japan's power supply. Units will be installed at Karita station, Kyushe Electric Power Company, and Kansai Electric Power Company's Osaka station. ♦ ♦

"About that leaky valve I reported this morning. Better send the new one in by boat."

DROP FORGED STEEL
valves, fittings and flanges by Vogt

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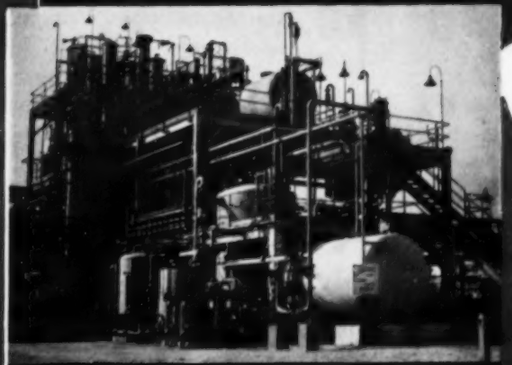
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There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services.

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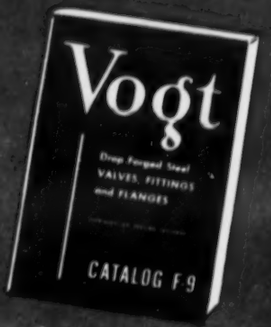

HENRY VOGT MACHINE CO. ... 75th Anniversary ... LOUISVILLE, KY.

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

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OXYGEN

key to modern industrial processes

Control it with...

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OXYGEN ANALYZERS!

Oxygen is one of the most important factors found in modern chemical and industrial processes. Whether to minimize product oxidation (prepared atmospheres, air infiltration, etc.) ... or to insure adequate oxygen for efficient combustion (boilers, kilns, etc.) ... or to control oxygen for proper process operations (ammonia, acetylene, air fractionation, etc.) oxygen control has become too important in today's operations for any profit-minded executive to overlook.

And because they are the *only* instruments that measure oxygen content directly, accurately and conveniently, Arnold O. Beckman Oxygen Analyzers have become the leading instruments for modern oxygen control in a wide range of applications—from catalytic refineries to cement kilns—from power plants to personnel protection.

These instruments (and systems) can be built to meet *your individual* needs.

These instruments offer many unique advantages...

SELECTIVITY: Highly sensitive to oxygen. Effects of gases other than oxygen are negligible.

HIGH ACCURACY: 1% of full scale (Example: ±0.05% O_2 on range 0-5% O_2).

MANY RANGES: Full scale ranges from 0-1000 ppm or up to 0-100% O_2 available. Combustion ranges 0-5, 0-10, 0-15% O_2 supplied with 0-25% O_2 check range. Multi-range instruments available.

RAPID RESPONSE: Standard Analyzers—95% response in less than 1 minute. Special Units—95% response in 7 **seconds!**

USE ANY RECORDER: Millivolt output for potentiometers; current output for miniature electronic recorders and galvonometers; air output for pneumatic receivers and control systems.

PACKAGE UNITS: Analyzers and controls may be built into a cubicle with sampling components wired, piped, and ready for installation as a single unit.

SAMPLING SYSTEMS: Complete standard systems—components, package or portable units are available.

OTHER ADVANTAGES: Instruments may be mounted in explosion-proof cases, mounted indoors or outdoors, in portable panels, and have other desired features.

Model F3: Ranges of 0-1%, 0-5%, 0-10%, and higher. Meter on door for convenient readings at sampling point.

Model G2: Full scale ranges 0-0.1%, 0-0.5%, and others for low O_2 content. Ranges 90-100%, 95-100% O_2 for high O_2 content.

The above are but two of the complete line of Arnold O. Beckman Oxygen Analyzers available for every requirement.

Send for helpful free literature which describes Arnold O. Beckman instruments in detail. When writing, outline your particular application—we'll gladly supply specific information.

To expedite replies please ask for Data File 20C-47.

Arnold O. Beckman INC.

ANALYZERS

Profit Builders for Industry

1020 Mission Street

South Pasadena, California

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this month's comment . . . .

. . . Engineers — technicians or managers?

You probably have heard the story about the man who worked sweeping floors in a canning factory. Everybody liked him because he was so cheerful — a happy, friendly worker. So the foreman promoted him, at twice his former wage, to the simple job of sorting apples from pears as they rolled along a conveyor. The second day on his new job he was tense. The third day he was mean. On the fourth day he came to the foreman and quit. "I just can't take it. Decisions, decisions, always decisions."

Engineers with decision-making responsibilities have a lot tougher job than sorting apples from pears. But the ability to cope with making decisions small and large, day in and day out, makes the difference between the engineer as a technician and the engineer as a manager.

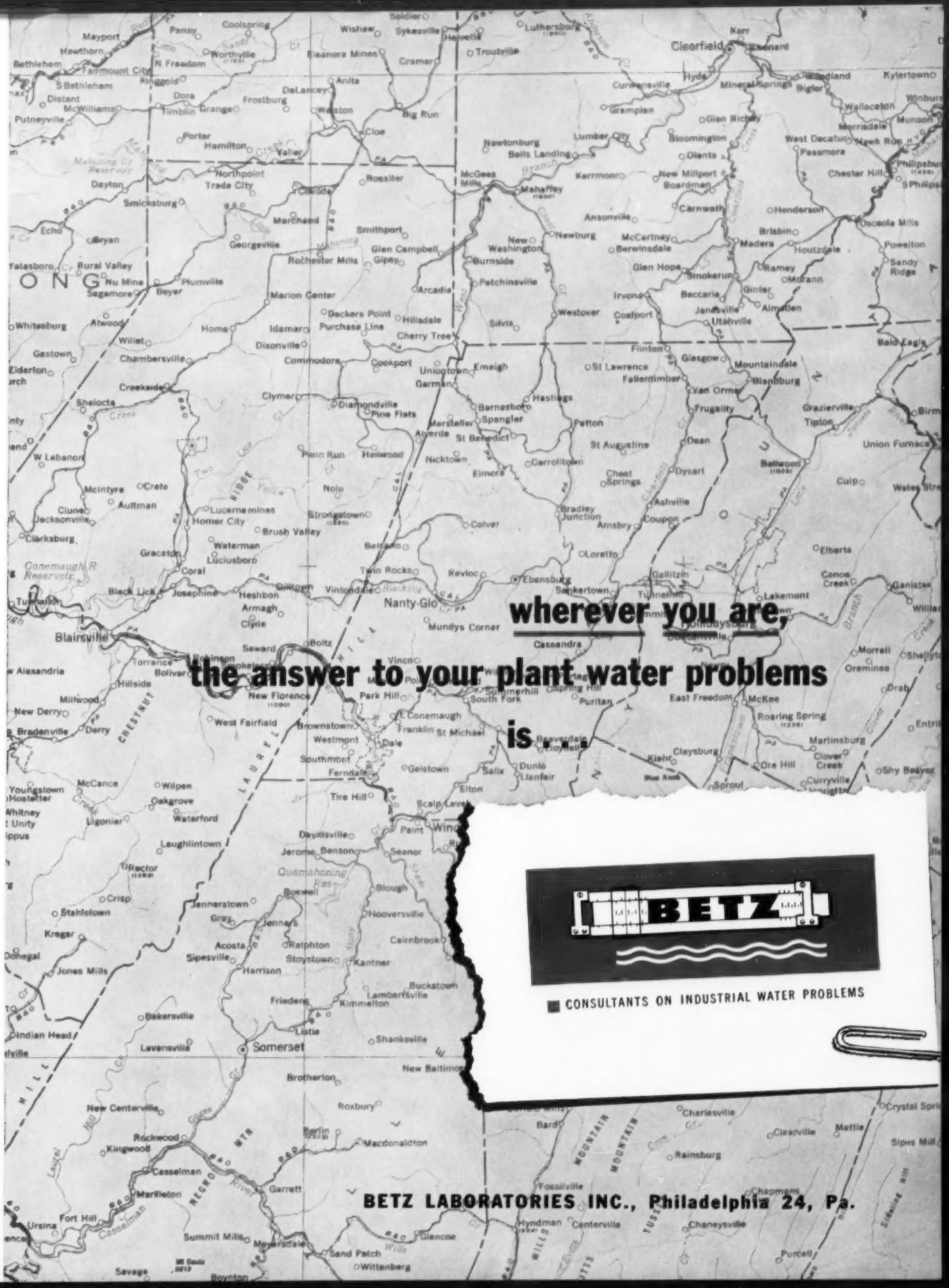
Too often the engineer is thought of, by himself as well as by others, as being a man whose job is merely to analyze. Direct, step-by-step analysis is, of course, necessary before making a decision — but the time always comes when the decision must be made, and in major decisions the unmeasurable intangibles can outweigh the statistical analysis. The ability to make a decision when the answer isn't completely clear is another requirement of the manager.

Why is it so important for engineers to recognize these differences between technicians and managers? Because over the past decade, and now at a greatly accelerated pace, it is engineering management that makes many major company decisions. Purchasing capital equipment, revamping and modernizing plant facilities, selecting fuel, locating a site for a new plant — these are just some of the major decisions engineering management makes. Added to these are the many day-to-day decisions on equipment purchase and installation, solving operating problems, handling personnel.

When the engineer combines his training and experience as an engineer with the abilities and techniques of managing, he is a tremendous combination for which there is great need throughout all industry.

John Paul Taylor

John Paul Taylor
Editor and Publisher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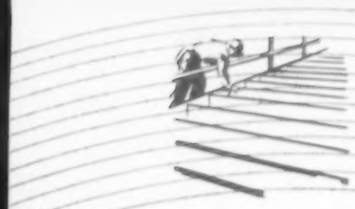

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About Ralph J. Cordiner

Ralph J. Cordiner was born in Walla Walla, Wash., in 1900. He majored in economics at Whitman College and financed his education by selling washing machines and other domestic appliances.

After graduation, Mr. Cordiner joined the Edison General Electric Appliance Co., a General Electric Company affiliate. He progressed through positions of increasing responsibility to become manager, Appliance and Merchandising department, for the General Electric Company in 1938.

During World War II, he was called to Washington as director general of war production scheduling for the War Production Board. Three months later, he was appointed vice chairman of the Board.

When Charles E. Wilson retired, Mr. Cordiner was elected to succeed him as president of the General Electric Company.

Since becoming president, Mr. Cordiner has established a new organizational structure based on the concept of "decentralization." As an adjunct to this program, the General Electric Company has launched an extensive program of manpower development at all levels. A feature of this program is the Company's Management Research and Development Inst., Crotonville, N. Y.

Mr. Cordiner is a member of the Committee for Economic Development, NEMA, the Economic Club of New York, AMA, the Electric Manufacturer's Club, and the Business Advisory Council of the Department of Commerce.

New skills are required for Modern Managers

RALPH J. CORDINER, President
General Electric Company

IT SEEMS CLEAR that past patterns of successful management are not adequate for today, and that even today's best will fall short of the ever-increasing demands of the years to come. Regardless of the size or variety of the enterprise that today's executive is called upon to manage, he finds it increasingly difficult to keep in view the total assignment, the ever-widening range of mangerial responsibility.

I would like to suggest to you some of the challenges that will have to be met, and some of the new skills that will have to be acquired and used, if we are to be successful executives in the years ahead. We are concerned here not only with our personal careers, but also with the careers of our successors after we are on the retired list.

The businessman is sometimes pictured as a reactionary defender of the status quo, but it might be more accurate to say that in the business world of the United States, there is no status quo. There is only a changing pattern of innovation and obsolescence.

Yet I wonder whether, in all this turmoil of innovation and change, we managers sometimes have the foolish idea that we personally stand apart, unchanging, exempt from obsolescence.

Let us have the humility and the frankness to admit that managerial attitudes and skills, like any others, are subject to rapid obsolescence in this age of change. The manager who does not keep up with the times — or rather, keep up with the future — is going to find himself as obsolete as yesterday's newspaper, and almost as quickly.

Most of us start our careers in one of the non-managerial functions, such as marketing, engineering, research, manufacturing, finance, relations, or law. Successful experience in one or more of these functions appears to be a necessary apprenticeship for perceptive managing. But it is now becoming clear, as certain pioneers have insisted all along, that managerial work is essentially different from these other functions, just as they are different from each other.

Those critics who profess to find a cult of "conformity" or "mediocrity" in business today have, in my opinion, been seriously misled by their own preconceptions. Today's successful manager must still be a man of uncommon energy, uncommon will power, and uncommon preceptiveness. But he needs more than these traditional virtues of the successful businessman.

Increasingly, the successful manager in America will be an intelligent and dedicated individual who sees managing as a distinctive profession in itself, with its own set of professional ethics, its own body of learning, and its own classifications of work. As in other professions, competence in this field will require specific study and experience, as well as the development of a distinct philosophy and mode of action appropriate to the profession.

One of the great unanswered challenges to professional managers is the challenge of recognizing that ideological forces, no less than market forces, have decisive effects on the survival, growth, and profitability of a business. The ideological challenge is definitely more difficult to deal with — because it is unfamiliar. The more we businessmen are attacked on the political front, the more we seem to withdraw, with our feelings hurt, to work harder on the material assignment of producing goods. But this will not solve the problem.

The whole political and social environment in which business operates has changed, is changing, and will continue to change. To put it simply, people expect more of us businessmen, and the skills which served an earlier day are not adequate for today.

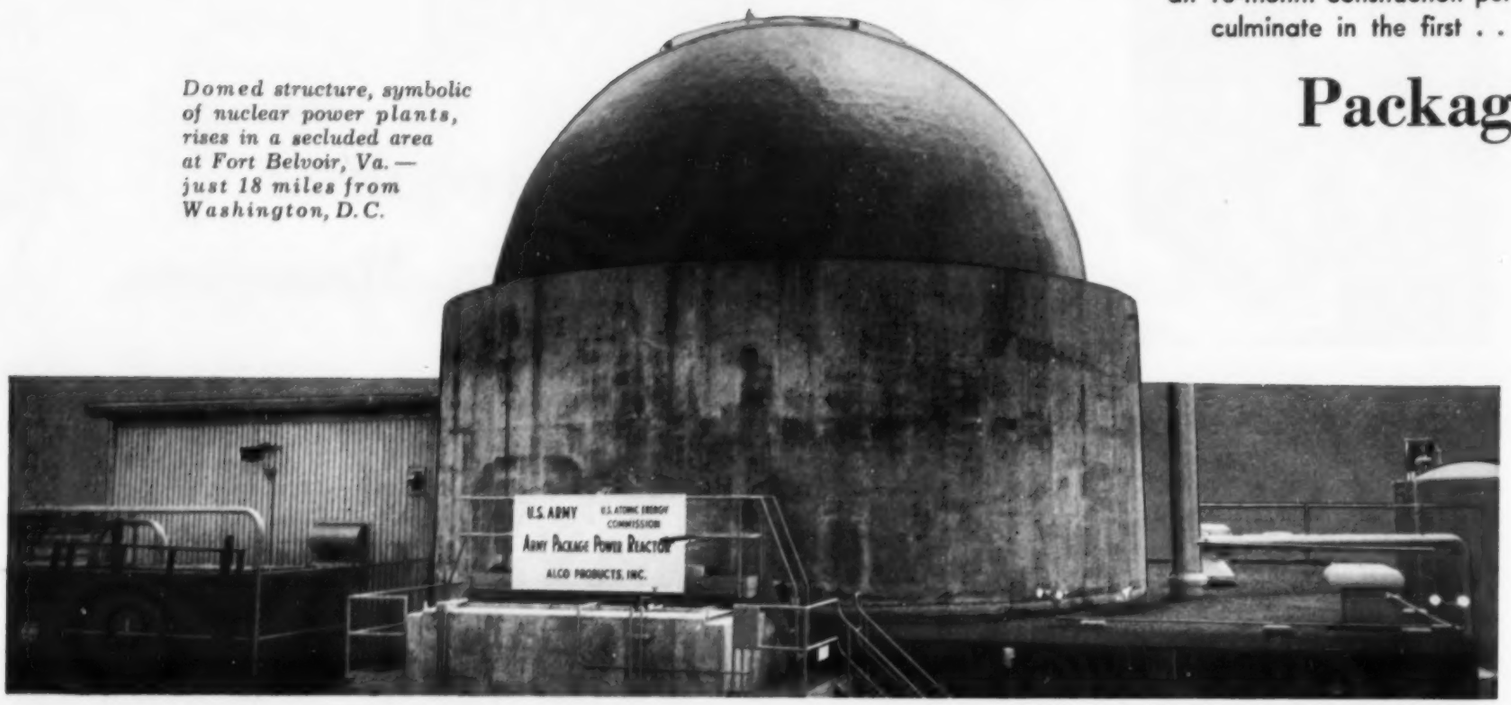
Increasingly the people expect business not only to satisfy

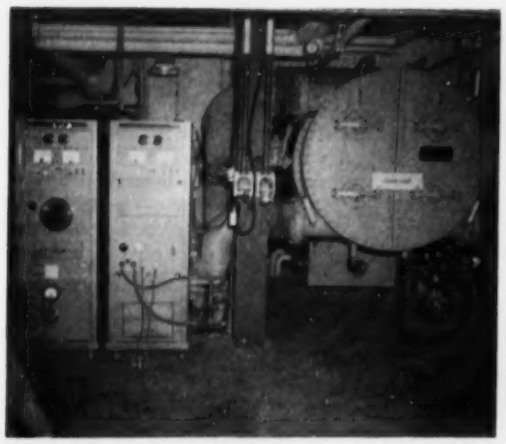
(continues on page 32)

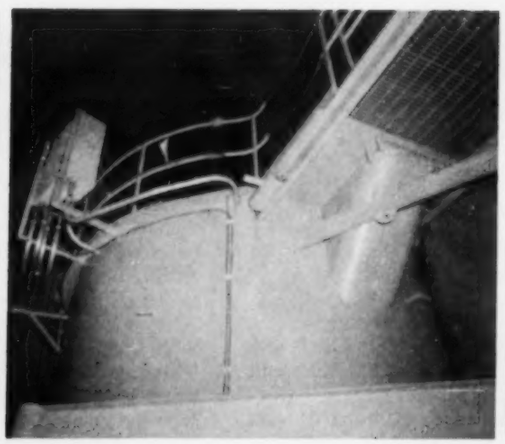
The combined engineering talents of over 100 suppliers and constructors during an 18-month construction period culminate in the first . . . .

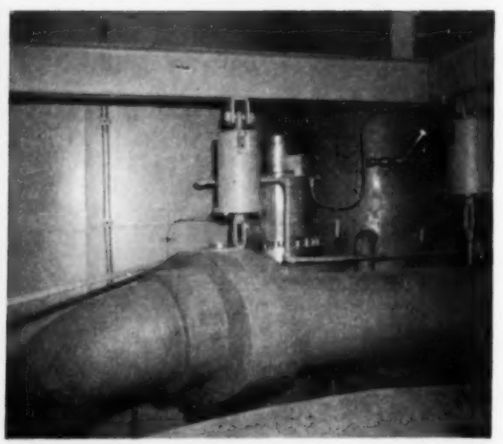
Package

Domed structure, symbolic of nuclear power plants, rises in a secluded area at Fort Belvoir, Va.— just 18 miles from Washington, D.C.









Secondary system condenser (upper left) minimizes makeup water requirements. Walkway to working platform facilitates refueling and inspection (upper center). Primary water system header brings high-pressure, high-temperature water to steam generator (upper right). Control console (lower left) has graphic panel, remote indicating instruments, controls. Turbogenerator (below) is outside vapor container.

Nuclear Power Plant

Reported by Robert W. De Moss

THE ARMY'S FIRST nuclear power plant, Army Package Power Reactor, is now in operation at Fort Belvoir, Va. It is the first prototype in a series of nuclear power plants under development by the Atomic Energy Commission and the Department of Defense for use by the three military services. Estimated cost of the reactor is $3,500,000, which includes testing (700-hr test and 6 months operation following initial test).

The APPR-1 is a pressurized-water reactor with design operating pressure of 1200 psig at 450 F. Design full thermal power output is 10,000 kw.

Instrumentation for APPR-1 was built and tested by Minneapolis-Honeywell. Instrumentation system is in four units: operator's console, graphic panel (depicting all piping, pumps, valves, and heat exchangers), and two panels containing full-size indicators and recorders.

Scramming is accomplished by release clutches holding control rods out of the reactor during operation. Two of the three safety channels must agree that scramming is required to prevent a "scram-happy" condition of operation. Scram will be initiated if pressure reaches 1450 psig and if reactor outlet temperature increases to 470 F.

The APPR-1 is a highly stable reactor with a strong negative temperature coefficient. Because of the high temperatures and pressures at which reactor operates, additional safeguards are provided.

Fuel elements, designed and built by the Oak Ridge National Laboratory, consists of an intimate mixture of enriched Uranium dioxide (as fuel material), Boron carbide (as the burnable poison), and stainless-steel powder. Fuel elements are arranged in the core in a 7 by 7 square array with the corners missing, and with seven of the 45 positions occupied by control rods. Fuel elements contain enough fuel to operate the reactor continuously for 18 months at full thermal power.

Conventional generating, transmission, and control equipment was designed and supplied for the reactor by the General Electric Company.

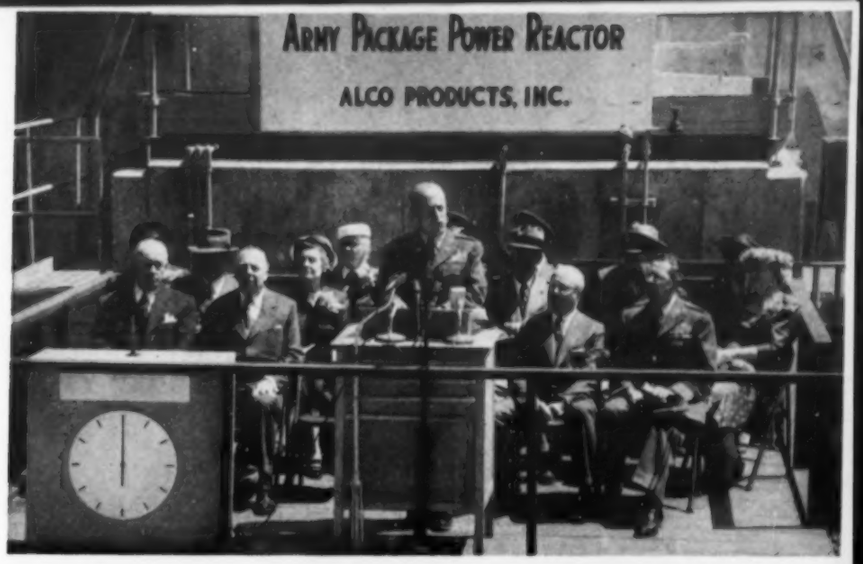
Steam generator receives slightly radioactive water at 450 F from the primary system. Secondary system water is converted into steam by contact with the 326-tube heat exchanger. Steam is produced at the rate of 34,070 lb/hr at 200 psi and 407 F (25 F superheat).

Primary cycle is water circulated by using Westinghouse Electric Corp. "canned-rotor" pumps. No primary water is circulated in the secondary system, so no shielding is required. The entire secondary system, except for the steam generator, is located outside the vapor container.

Primary water system contains 1300 gallons, circulated at 4000 gpm. Final water treatment consists of passing water through General Ionics Corp. demineralizers, each containing 2 cu ft of resin. To prevent radiation hazards, the resin is periodically removed and discarded.

The APPR-1's prime objective is to furnish power to remote military installations without the troublesome and often impossible logistic considerations of fossil fuel supply. Other major objectives, however, are:

- To obtain operating paramenters and engineering test data necessary to adapt the system to operating climates in remote areas
- To provide training facilities for troops and specialists who eventually will be needed to work remote plants. ♦ ♦

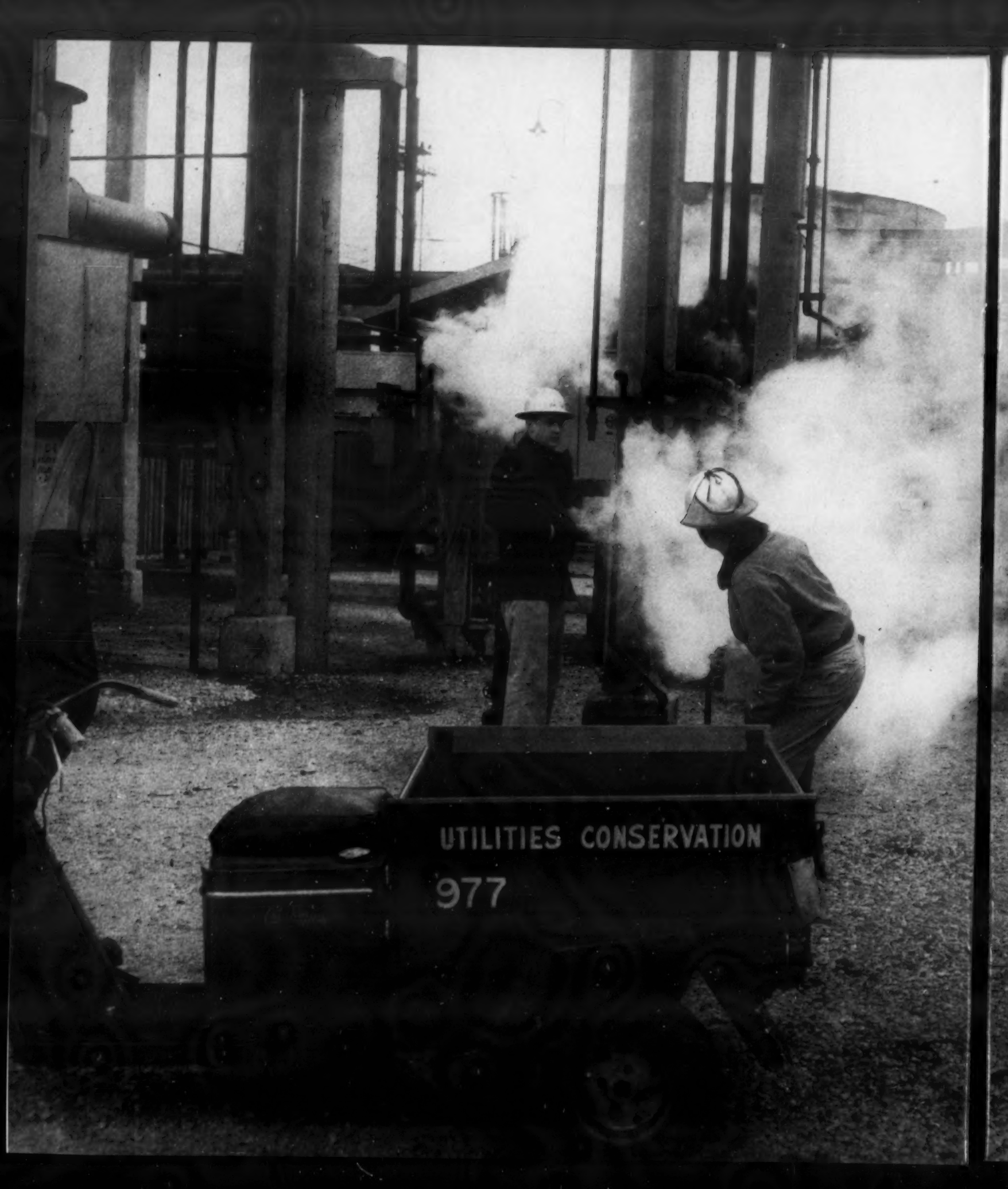


▲*Dignitaries attending dedication ceremonies at Fort Belvoir include (left to right) P. T. Egbert, president, ALCO Products Inc., The Honorable Wilber M. Brucker, Secretary of the Army, Major General Emerson C. Itschner, Chief of Army Corps of Engineers, The Honorable Lewis L. Strauss, Chairman AEC, and Brigadier General Franklin A. Tobey, Army Deputy Chief of Chaplains.*

Wilber M. Brucker, ▶ *Secretary of the Army (left), and Lewis L. Strauss operate switch to start the reactor.*

Does Army Package Power Reactor foretell unusual uses for small reactors?

Practicality of APPR-1 in view of present-day economics and technology may be argued at great lengths by many well-known engineers. Military authorities admit that from 50 to 100 cargo planes will be required to deliver the reactor to remote sites. A minimum of six months will be required to erect the reactor. There is the possibility, however, that our military experts, AEC, and U. S. Army engineers are looking forward to the day of manned satellites. Would APPR-1 not be ideally suited, with technological improvements, to furnish power for installations such as these? Possibly a more compact, more efficient version of this original small prototype reactor will be the difference between the success and failure of such a venture.


UTILITIES CONSERVATION
977

One of the country's largest refineries is saving huge sums in conservation enforcement. Here's their experience to help you . . . .

Get more for your services dollar

Many thousands of dollars are saved annually at a large midwestern refinery by recognizing the economic importance of power services in total operation. For instance, with a crude run to the refinery averaging over 200,000 barrels per day, power station water treating facilities process approximately 150,000 barrels of raw lake water per day.

FRANK D. SQUIER
Staff Engineer

Frank D. Squier was born in Denver, Colo. 35 years ago. He served three years with the U. S. Army Corps of Engineers in Canada, Africa, and Italy. He graduated from University of Colorado with B.S.M.E. in 1946. Then he worked for three years as a design engineer and construction contract writer at the refinery. In 1950, he joined Raymond division of Combustion Engineering as a service engineer, but returned after three years to the refinery. Squier is a registered professional engineer, State of Indiana. He spends his spare time tinkering with the family car and the family dwelling, and working for his church. He relaxes to Dixieland music.

INVESTMENT and cost figures for a petroleum refinery operation are large. Thousands of men in the Operating and Maintenance division earn a combined weekly paycheck of $1 million. Fuel and power services costs are an important part of refinery expenses and require constant attention.

Various process units are individually charged for the services they use. The major items, steam, fuel, and electricity, are accurately metered to the units. Other services are charged on the basis of periodic surveys that are used to pro-rate total consumption to the various units within reasonable limits of accuracy. Cost of a given quantity of any one of these utilities is based upon the actual expenses incurred in producing the item. These production costs include labor, supervision, maintenance, and plant overhead. No charges are included for insurance, taxes, or depreciation on utilities equipment.

Since all utilities produced are consumed within the plant, determination of specific charges for utilities becomes a matter of accounting. At this plant, the practice is to allocate insurance, taxes, and depreciation on utilities equipment to the several refinery process departments. The absence of such items in the charges to process units reduces unit power services charges, and makes the need for utilities conservation less obvious to the average employee.

Just as the ultimate success of any civil law depends upon the individual citizen's observance, power services conservation depends upon the cooperation of each employee. Just as laws must be enforced, so must conservation be demonstrated and, at times, enforced.

Partial organization chart illustrates the upper-level positions in the Utility division. All men holding these jobs are graduate engineers, most of whom started their service with the company Engineering division. The six staff engineers in the Conservation department are non-supervisory professional employees with grades and pay levels comparable to Engineering division staff engineers. Conservation is the primary responsibility of these engineers, though they occasionally function in other staff duties for Utility division supervisors. Design of equipment and facilities for the Utility divison is handled by engineering personnel. Vacancies in the supervisory jobs are normally filled by promoting an engineer from the conservation staff.

Steam and fuel represent about 94% of the total utility charges to the process units. Conservation effort, therefore, centers primarily upon these two items. The six staff engineers are normally divided equally between "Steam Conservation" and "Combustion Control." The former are responsible for taking all neces-

(continues on page 34)

Conservation department engineers patrol their areas looking for evidence of steam escaping or improper operation of steam equipment.

Meeting multi-load power requirements for office air conditioning, plant production, new product testing, and developing facilities, with future expansion in mind, gave General Electric's engineers a real test in designing G.E.'s new Roanoke, Va. plant. They realized that . . .

Today's plant requires a planned power system

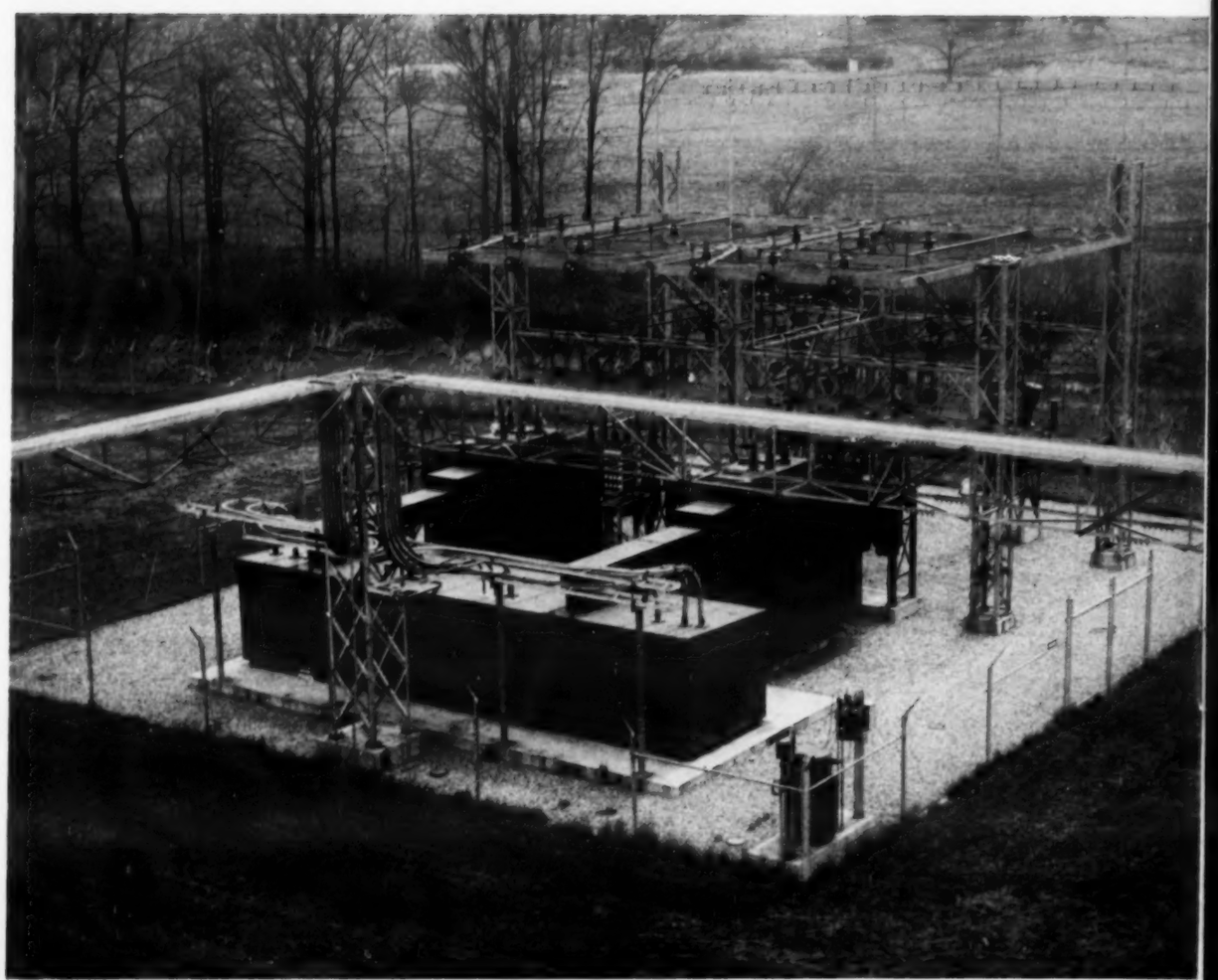
R. P. STRATFORD
Application Engineer
General Electric Company

POWER SYSTEM in General Electric's new Roanoke, Va. plant is designed to provide the most modern facilities for manufacturing industrial power control equipment as well as to provide for any future need.

In all plant facilities, power system had to be designed to meet special requirements of individual operations. Office area required lighting, receptacles for office machines and for air conditioning. Manufacturing area required special provisions for large resistance-welders and for large single-phase furnaces. Production test facilities must provide all voltages and frequencies met in any power system for which the industrial power control products are used. Testing and development laboratory has facilities for short circuit and life- and load-testing of products under development. This includes both ac and dc short circuit testing facilities.

The one-line plant diagram (Fig. 1) shows the main medium-voltage (4.16-kv) system feeding load-center substations and how typical loads are handled at 480 volts.

Two 34.5-kv power lines from the Appalachian Electric Company serve the plant. These two lines are from the same substations, but enter the



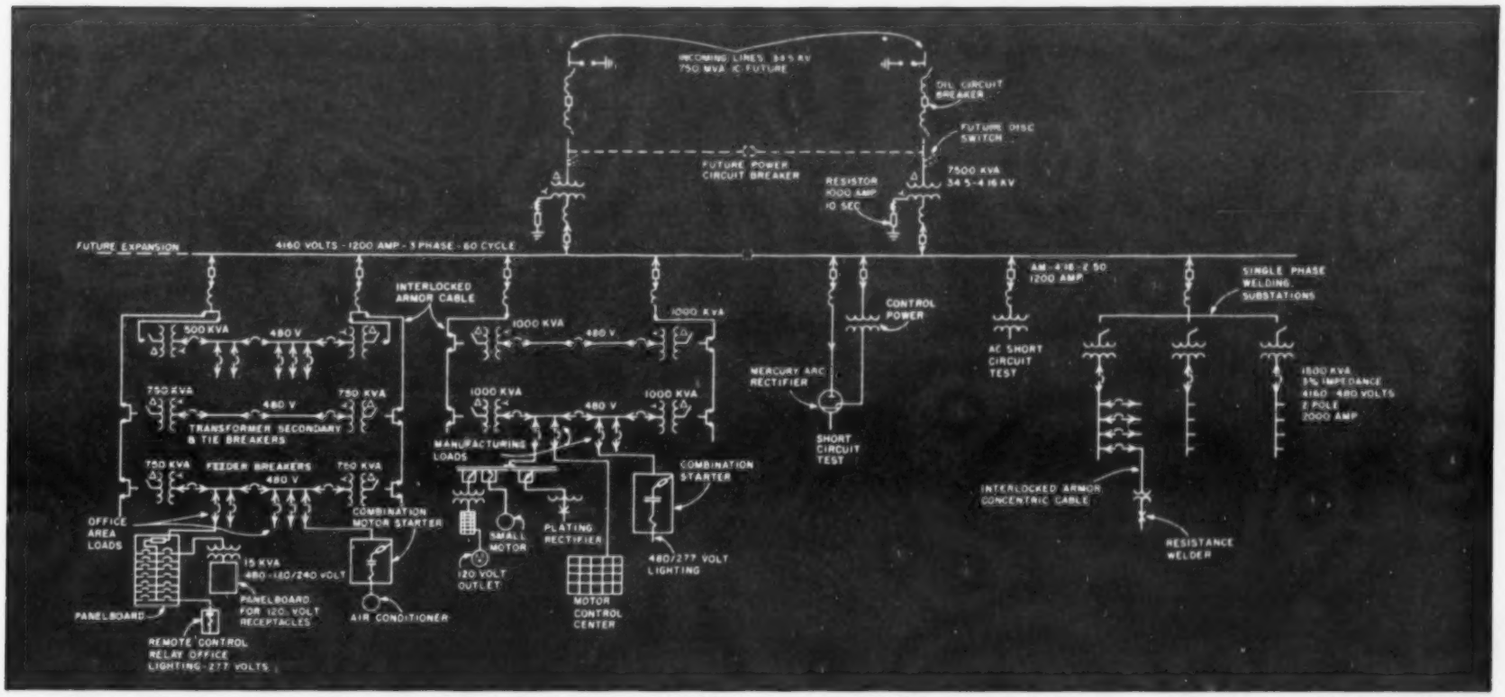


Fig. 1—One-line diagram shows variation in loads that are handled by power distribution system for Roanoke, Virginia plant. High service reliability is provided by connection between both the 34.5-kv incoming lines. Entire system can be operated from either power line.

plant on two different pole lines over different routes to provide high service reliability.*

The two incoming lines terminate in an outdoor substation. A power circuit-breaker controls each incoming line. Future horn-gap disconnect switches in each power transformer primary are arranged so that a future high-voltage tie circuit breaker can be added to allow either incoming line to feed one or both of the main step-down transformers.

Main step-down transformers are rated 7500 kva, 34.5 to 4.16 wye kv with transformer neutrals grounded through a current-limiting resistor. Load tap changing equipment is not used because incoming lines have less than ±1% voltage variation. These transformers are connected to outdoor metal-clad switchgear by a metal-enclosed bus.

Metal-clad switchgear is arranged for secondary selective operation. One of two buses normally feeds the plant distribution substation. Second bus normally feeds short circuit testing power supplies and resistance welding single-phase substations. A normally open tie breaker electrically separates the two buses to minimize voltage disturbance on the plant feeder. Metal-clad switchgear feeds various load center substations throughout the plant with interlocked armored cable. Cable runs in an overhead rack between outdoor substation and manufacturing building.

Package substation handles two incoming 34.5-kv lines. Plant feeders fit in overhead racks.

overall system designed for flexibility

Load-center substations are again arranged for secondary selective operation. Each substation includes two transformers and their associated low-voltage drawout switchgear. Transformers have wye-connected secondaries that are solidly grounded. Each end of the substations is fed from a different feeder in the metal-clad switchgear. Each transformer has its own secondary circuit breaker and each substation has a tie breaker that operates normally open.

If one cable feeder is lost, plant power is still obtained by closing the tie breaker in the load center substations and feeding the entire load from the one transformer. Tie breaker is key interlocked with secondary breakers to prevent parallel operation, which would exceed interrupting capacity of the air circuit breakers. Secondary selective system is used throughout the plant and gives maximum power reliability. Any metal-clad breaker feeder circuit can be shut down for repair without interrupting power flow to the load. In some cases, part of the load will have to be reduced to prevent transformer overheating.

General office load is mainly lighting and air conditioning. Lighting is designed to give 50-foot candles for the general area. By using an instant-start fluorescent ballast connected to the main 480/277-volt system, a demand of 4-volt amps/sq ft was used to figure the lighting load. Lights are switched by remote control relays operated from a 24-volt ac supply. An additional ½-volt amp/sq ft is provided in the office area for office machine receptacles. This 120-volt, single-phase ac is obtained from small (15-kva) dry-type transformers located near panelboards.

Office area is air conditioned by package units, rated 10 to 15 tons, located in alcoves in the main hall. Power is fed from the load-center unit substation to power supply panels and then to the individual units. A demand of approximately 4-volt amps/sq ft was used for the air-conditioning load.

General manufacturing layout is subject to change with each new product design change. So it was assumed that a uniform load density of 10-volt amps/sq ft (future 15-volt amps) would be the design basis for the power system. This was modified to include special high-density loads, such as furnaces and resistance welders. Plug-in busway is used to distribute power over the general plant area. Busway is rated 400 amps and is fed from individual circuit breakers located in load-center unit substations. Plug-in busway provides easy access to the 480-volt power system anywhere in the plant. Whenever a new machine is installed, power supply is available.

equipment grounding built-in to system

Special consideration was given to equipment ground for machines connected to the plug-in busway. Galvanized

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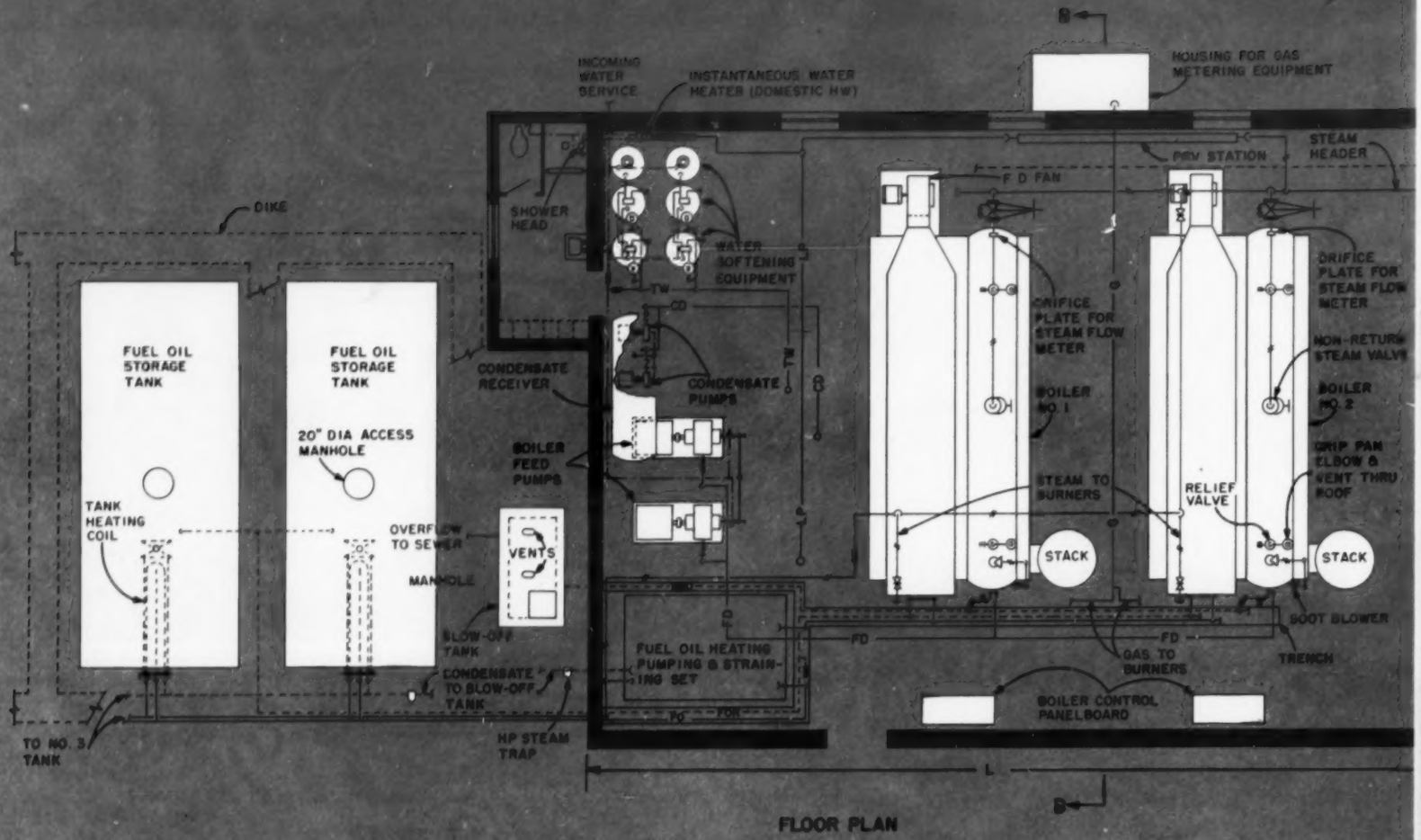
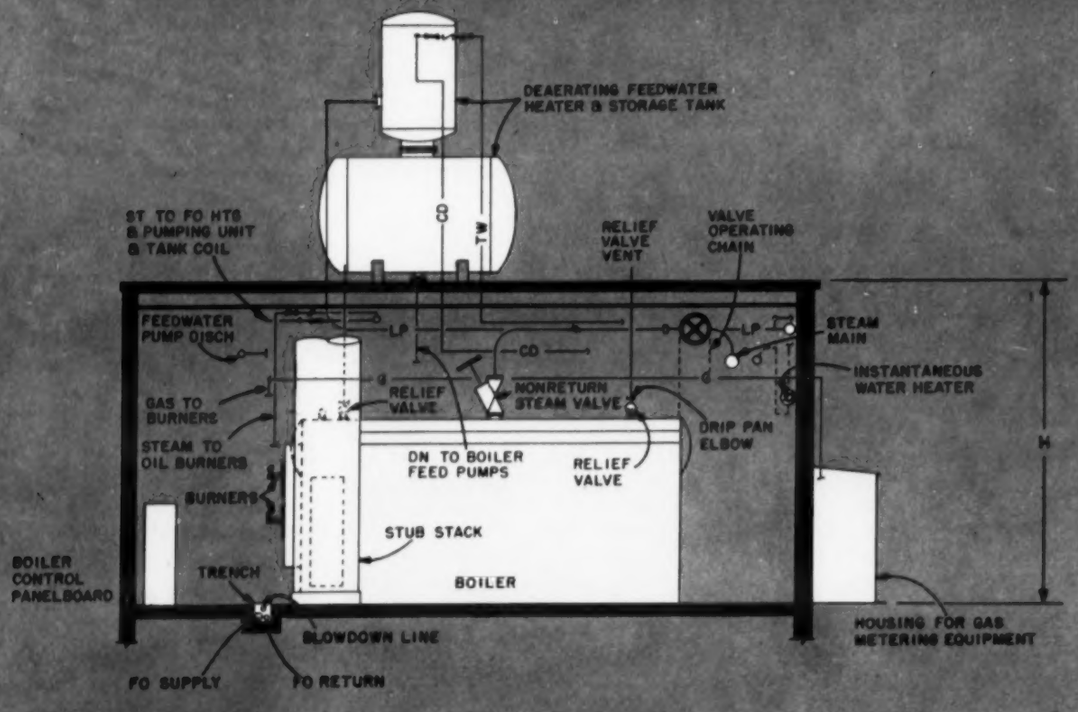

INCOMING WATER SERVICE
INSTANTANEOUS WATER HEATER (DOMESTIC HW)
HOUSING FOR GAS METERING EQUIPMENT
STEAM HEADER
PRV STATION
F D FAN
DIKE
SHOWER HEAD
WATER SOFTENING EQUIPMENT
ORIFICE PLATE FOR STEAM FLOW METER
NON-RETURN STEAM VALVE
FUEL OIL STORAGE TANK
FUEL OIL STORAGE TANK
20" DIA ACCESS MANHOLE
CONDENSATE RECEIVER
CONDENSATE PUMPS
BOILER NO. 1
BOILER NO. 2
DRIP PAN ELBOW & VENT THRU ROOF
BOILER FEED PUMPS
TANK HEATING COIL
OVERFLOW TO SEWER
VENTS
MANHOLE
STEAM TO BURNERS
RELIEF VALVE
STACK
STACK
BLOW-OFF TANK
FUEL OIL HEATING PUMPING & STRAINING SET
SOOT BLOWER
CONDENSATE TO BLOW-OFF TANK
GAS TO BURNERS
TRENCH
BOILER CONTROL PANELBOARD
TO NO. 3 TANK
HP STEAM TRAP
FLOOR PLAN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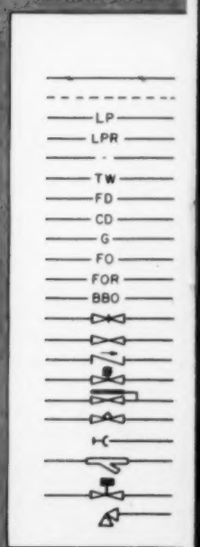
SECTION B-B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Your engineering department can save time and money if you need a boiler plant with 20,000 to 150,000 lb/hr capacity, by using U. S. Navy, Bureau of Yards and Docks . . . .

Basic steam plant design

JOHN W. BISHOP
Mechanical Engineer
Power Generating Section
U. S. Navy Department, Bureau of Yards and Docks

TO ASSIST you in selecting an austere but economically operating source of steam for processing and/or heating, U. S. Navy, Bureau of Yards and Docks has developed these basic steam plant outlines. They consist of two boilers in each case. Each plant has a temporary wall at one end of the building, permitting expansion to a three-boiler plant. Piping, deaerator, and fuel-handling equipment are sized for a three-boiler plant to facilitate future expansion. Suggested maximum dimensions for each type of plant are shown in Table I. Modifications must be made to fit specific conditions.

oil- and gas-fired plants are package type

Boilers for oil and gas firing (Fig. 1), are of the multipass, water-cooled furnace, factory-assembled, water-tube, "D" or "A" design, meeting Military Specification MIL-B-17095B. When specifying these boilers, quote the specification number and answer the questions in Section 6.1 of the specification *only*. This specification was cleared with all leading manufacturers of water-tube package boilers before its adoption and is being constantly revised. Any parallel or conflicting specification writing will generally tend to either raise the cost or lower the quality of the boiler, or both. The specification limits heat release to 60,000 Btu/cu ft/hr and average absorption to 9200 Btu/sq ft/hr. Units are essentially complete factory-assembled boilers with all trim and appurtenances: sootblowers, gages, combustion and feed controls, fans, and burners. They require only a flat foundation for mounting. Economizers can be added for the higher pressure units. (In making this decision, apply the economic principles set forth in INDUSTRY POWER, September 1956.) Boilers up to 20,000 lb/hr may be fully automatic (start and stop), operated with intermittent attendance. Larger sizes require only a one-man overall plant watch.

These boilers are now available to 50,000 lb/hr capacity for rail shipment on all minimum standard clearance railroads. Sizes up to 60,000 lb/hr are also available, where railroad clearances permit a slightly higher unit to be shipped.

coal-(aux. oil- or gas-) fired plants, field erected boilers

Present standard coal-fired plant (Fig. 2) utilizes field-erected, spreader-stoker-fired boilers with heat release limited to 40,000 Btu/cu ft/hr of furnace volume and 600,000 Btu/sq ft/hr of grate surface. Average heat absorption through tubes is limited to 8360 Btu/sq ft/hr. Grates may be dumping type or the newly developed vibrating or oscillating intermittent ash-discharge types. Another applicable type of coal-burning equipment is the recently designed chain grate stoker with high-velocity air jets located in the front wall above the incoming fuel bed. Oil or gas burners (or both) may be interchangeable with the stoker feeder or may be side mounted. Firing gas or oil requires covering the grates with loose firebrick or a layer of ash. Ash reinjection is provided from all collection hoppers, except the dust collector hopper. Fans are designed for 10% excess volume at 30% overpressure.

Combustion controls should be the metering type, controlling loading as a function of steam pressure and air as a function of fuel flow or steam flow. Controls must be capable of operating the oil or gas control valves (in addition to the stoker feed) where alternate fuel firing is provided. Feed controls are the single-element thermostatic type. Safety controls should consist of a low-water cutout plus flame failure controls for oil or gas firing. This plant is designed for one-man operation.

coal-fired plants with package boilers

In competition with the field-erected coal-fired design, a plant arrangement utilizing coal-fired package boilers is suggested (Fig. 3). The great savings possible from using factory-assembled package oil- and gas-fired boilers in lieu of field-erected boilers has caused

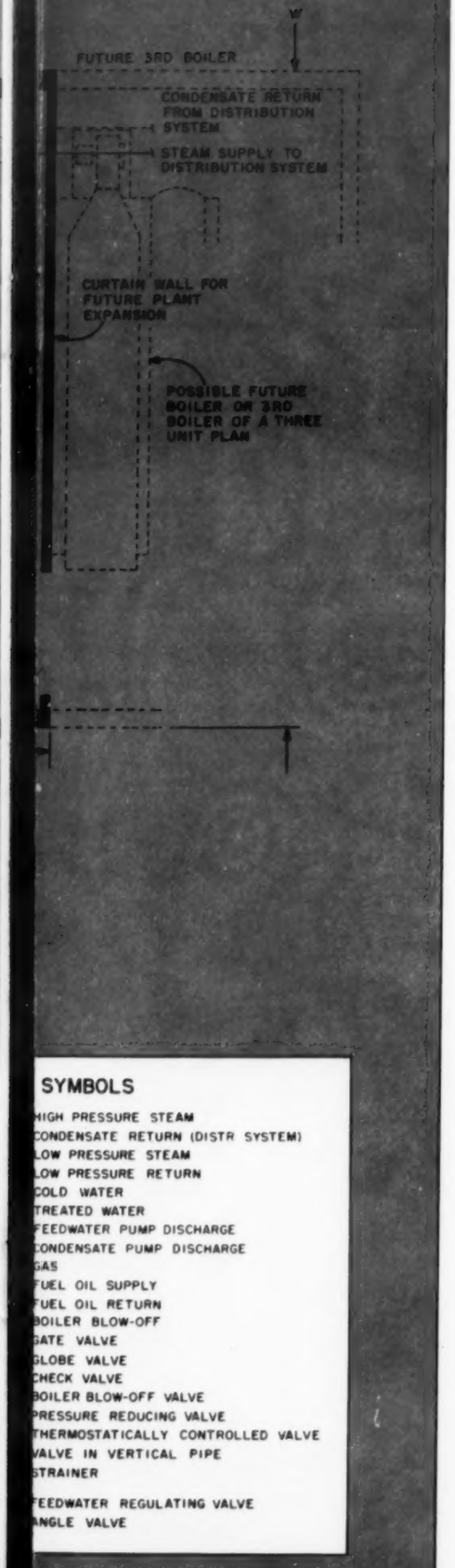
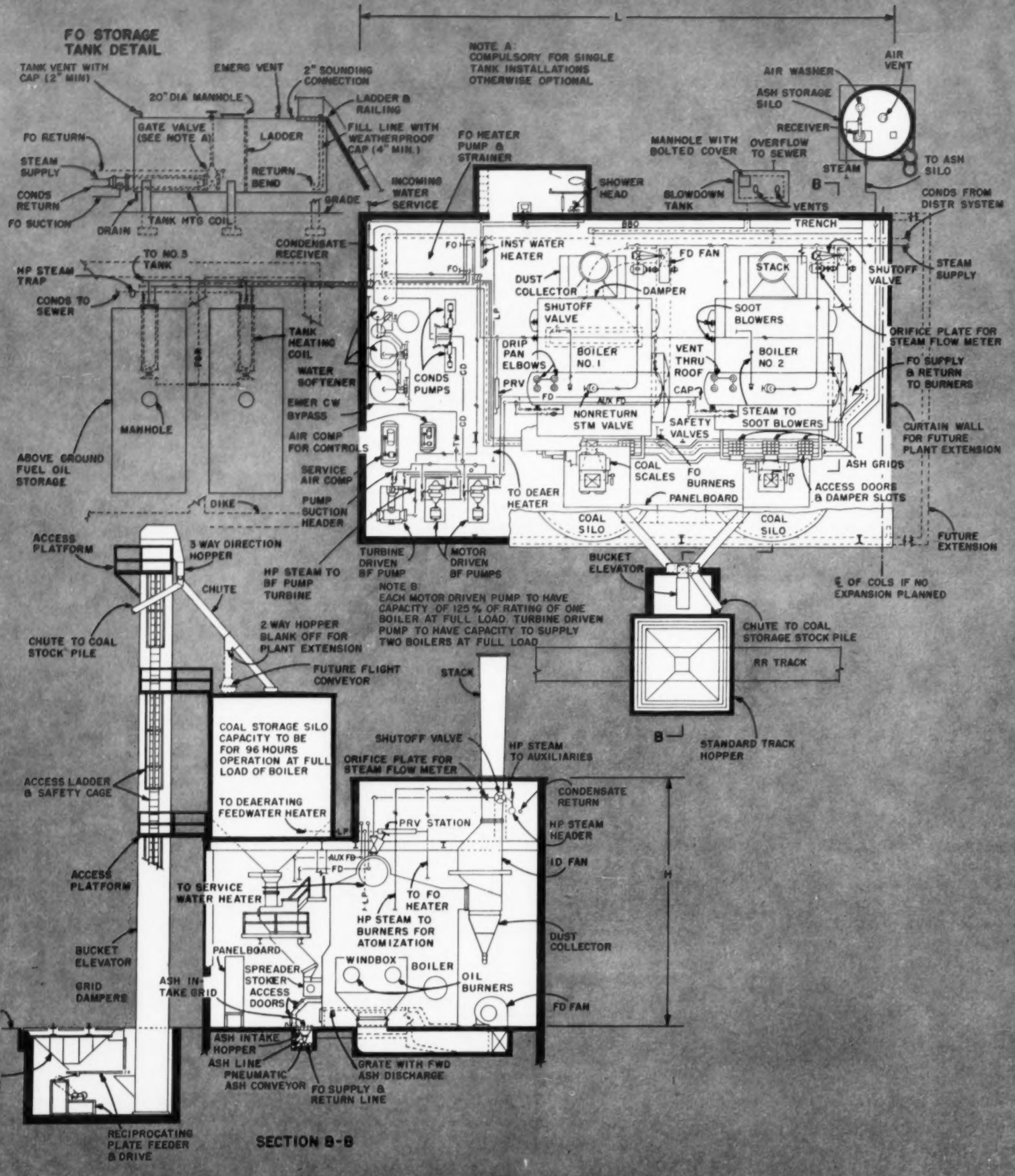


Fig. 1—Basic design for oil- and gas-fired boiler plant uses package-type water tube boilers as small as 10,000 lb/hr capacity each.


FO STORAGE TANK DETAIL
NOTE A:
COMPULSORY FOR SINGLE TANK INSTALLATIONS OTHERWISE OPTIONAL
TANK VENT WITH CAP (2" MIN)
EMERG VENT
2" SOUNDING CONNECTION
20" DIA MANHOLE
LADDER & RAILING
GATE VALVE (SEE NOTE A)
LADDER
FILL LINE WITH WEATHERPROOF CAP (4" MIN.)
FO RETURN
STEAM SUPPLY
CONDS RETURN
FO SUCTION
RETURN BEND
INCOMING WATER SERVICE
GRADE
DRAIN
TANK HTG COIL
FO HEATER PUMP & STRAINER
SHOWER HEAD
AIR WASHER
AIR VENT
ASH STORAGE SILO
RECEIVER
MANHOLE WITH BOLTED COVER
OVERFLOW TO SEWER
TO ASH SILO
STEAM
BLOWDOWN TANK
VENTS
CONDS FROM DISTR SYSTEM
TRENCH
CONDENSATE RECEIVER
TO NO.3 TANK
HP STEAM TRAP
CONDS TO SEWER
INST WATER HEATER
FD FAN
STACK
DUST COLLECTOR
DAMPER
SHUTOFF VALVE
STEAM SUPPLY
SOOT BLOWERS
ORIFICE PLATE FOR STEAM FLOW METER
TANK HEATING COIL
WATER SOFTENER
DRIP PAN ELBOWS
BOILER NO.1
VENT THRU ROOF
BOILER NO.2
FO SUPPLY & RETURN TO BURNERS
CONDS PUMPS
PRV
CAP
EMER CW BYPASS
NONRETURN STM VALVE
SAFETY VALVES
STEAM TO SOOT BLOWERS
CURTAIN WALL FOR FUTURE PLANT EXTENSION
MANHOLE
ABOVE GROUND FUEL OIL STORAGE
AIR COMP FOR CONTROLS
COAL SCALES
FO BURNERS
ASH GRIDS
SERVICE AIR COMP
TO DEAER HEATER
PANELBOARD
ACCESS DOORS & DAMPER SLOTS
DIKE
PUMP SUCTION HEADER
COAL SILO
COAL SILO
FUTURE EXTENSION
ACCESS PLATFORM
3 WAY DIRECTION HOPPER
TURBINE DRIVEN BF PUMP
MOTOR DRIVEN BF PUMPS
BUCKET ELEVATOR
HP STEAM TO BF PUMP TURBINE
NOTE B:
EACH MOTOR DRIVEN PUMP TO HAVE CAPACITY OF 125% OF RATING OF ONE BOILER AT FULL LOAD. TURBINE DRIVEN PUMP TO HAVE CAPACITY TO SUPPLY TWO BOILERS AT FULL LOAD
℄ OF COLS IF NO EXPANSION PLANNED
CHUTE
CHUTE TO COAL STOCK PILE
2 WAY HOPPER BLANK OFF FOR PLANT EXTENSION
CHUTE TO COAL STORAGE STOCK PILE
RR TRACK
FUTURE FLIGHT CONVEYOR
STACK
COAL STORAGE SILO CAPACITY TO BE FOR 96 HOURS OPERATION AT FULL LOAD OF BOILER
SHUTOFF VALVE
HP STEAM TO AUXILIARIES
ORIFICE PLATE FOR STEAM FLOW METER
STANDARD TRACK HOPPER
ACCESS LADDER & SAFETY CAGE
TO DEAERATING FEEDWATER HEATER
CONDENSATE RETURN
PRV STATION
HP STEAM HEADER
ID FAN
ACCESS PLATFORM
TO SERVICE WATER HEATER
TO FO HEATER
HP STEAM TO BURNERS FOR ATOMIZATION
DUST COLLECTOR
BUCKET ELEVATOR
PANELBOARD
WINDBOX
BOILER
OIL BURNERS
GRID DAMPERS
ASH INTAKE GRID
SPREADER STOKER ACCESS DOORS
GRADE
FD FAN
ASH INTAKE HOPPER
TRACK HOPPER
ASH LINE PNEUMATIC ASH CONVEYOR
GRATE WITH FWD ASH DISCHARGE
FO SUPPLY & RETURN LINE
RECIPROCATING PLATE FEEDER & DRIVE
SECTION B-B

the Navy's Bureau of Yards and Docks to spearhead development of the factory-assembled coal-fired package boiler, with capacities to 44,000 lb/hr. Two units of 12,500 lb/hr capacity have been installed at a West Coast Air Force base and a 30,000 lb/hr, capacity unit is scheduled for delivery in 1957. Up to capacities of 20,000 to 25,000 lb/hr boilers generally will have longitudinal drums and be the "A"- or open-bottom "D"-type construction. Above these capacities, furnace dimensions (within railroad clearances) dictate a cross-drum arrangement. Fig. 3 shows an arrangement using the cross-drum type boilers and Fig. 4 shows a phantom view of this boiler-stoker-dust collector combination.

These boilers, as presently constructed, come in three packages: a stoker-foundation package, mounted on a flat slab foundation; a boiler package; and an induced-draft fan and dust collector package. The induced draft fan-dust collector package may be omitted on high-velocity, overfire-air, chain grate stoker-fired boilers. The three (or two) units are bolted together in the field with no skilled labor required. Stokers shown here are the vibrating- or oscillating-spreader type, with fully automatic ash discharge. Ash is reinjected from hoppers under the boiler passes.

Oil and gas burners are interchangeable with the stoker feed where alternative fuel firing is desired. Otherwise, these coal-fired packages are similar to their oil and gas-fired counterparts. Coal feed is automatic via a slowspeed screw conveyor from an elevated silo. Only one operator is needed for this plant.

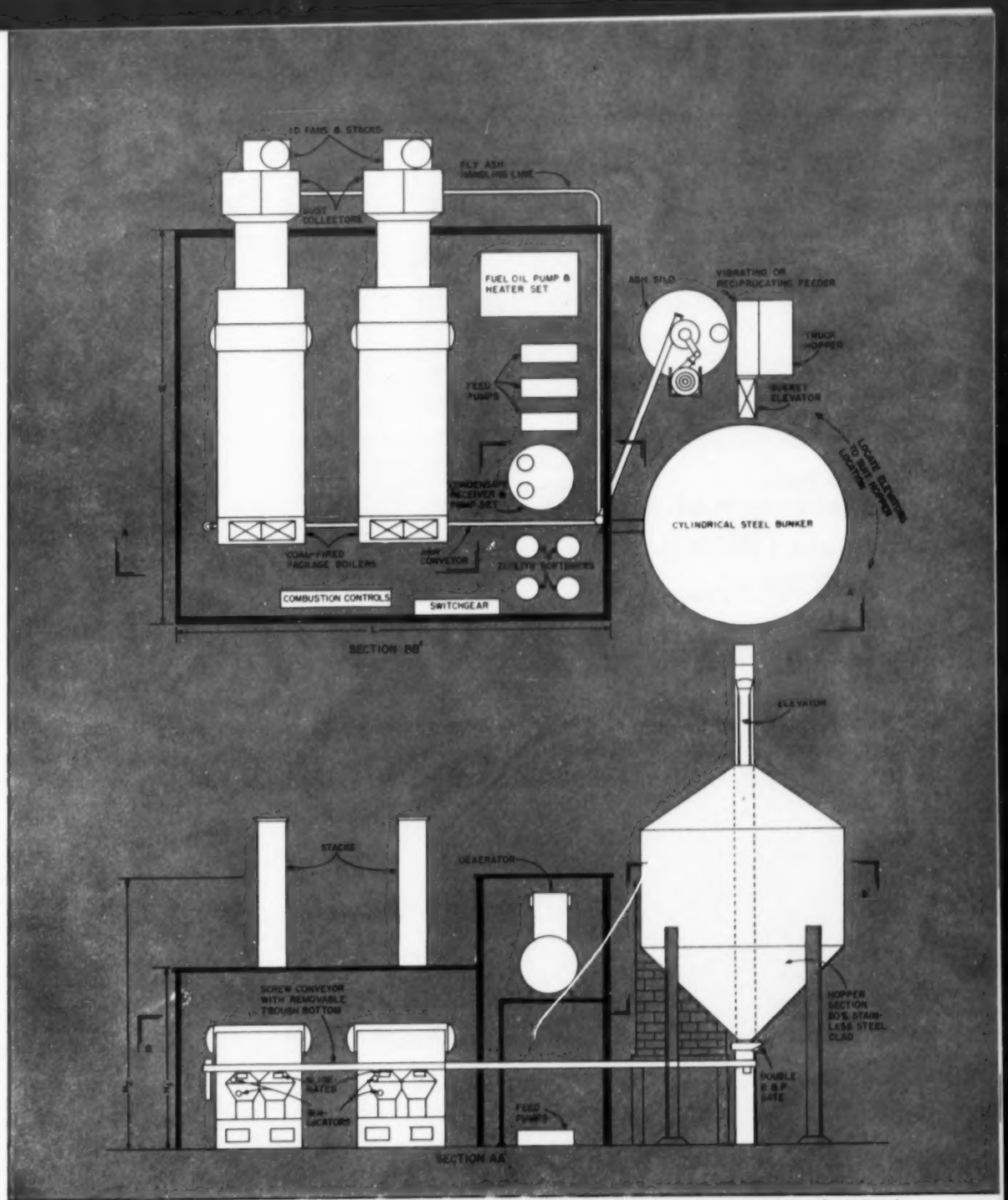


Fig. 3—Design for plant with coal-firing package boilers developed by U.S. Navy, Bureau of Yards & Docks.

what about auxiliaries that are required?

Sufficient steam-driven auxiliaries should be provided to take advantage of deaerator steam requirements during average demand periods. Sufficient electric-driven auxiliaries should be included to prevent wastage by exhausting steam to atmosphere when operating during light-load periods.

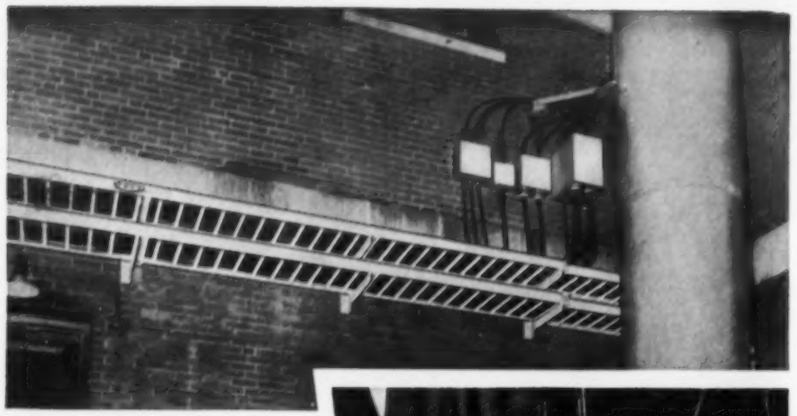
Wherever oil firing is used, two above-ground tanks should be provided, using suction heaters to avoid heating the entire tank. Provision for unloading must be included. In cold climates, oil lines should be steam traced. A dual pump and heater set should be provided with one pump and heater capable of handling 80% of rated plant capacity.

An elevated silo that receives coal from a track or road hopper via a flight conveyor is recommended. A chute from the conveyor top should be provided to divert coal to a storage pile. Stored coal is then reclaimed by a small bulldozer that pushes the coal into the track or road hopper. Ashes may be removed manually or automatically via an ash conveyor or sluicing arrangement to an ash silo or to a Dumpster-type container.

Where a small load is anticipated during certain periods, a small electric-driven feed pump should be provided, and the deaerator should be tray type. Internal chemical treatment usually consists of one high-pressure chemical pump and tank set for direct boiler feed of phosphate and caustic soda, and one low-pressure pump set for feeding sulfite to deaerator effluent. Testing

(continues on page 37)

Fig. 2 — Basic coal-fired (aux. oil or gas) plant utilizes field-erected water-tube boilers.



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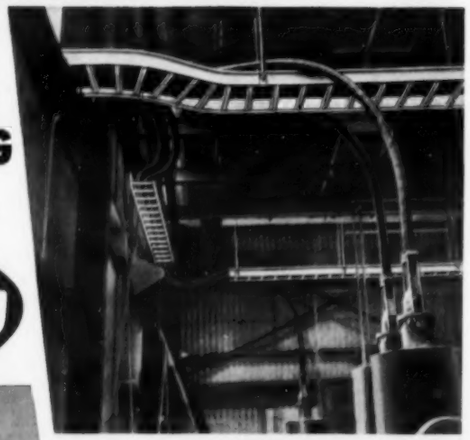

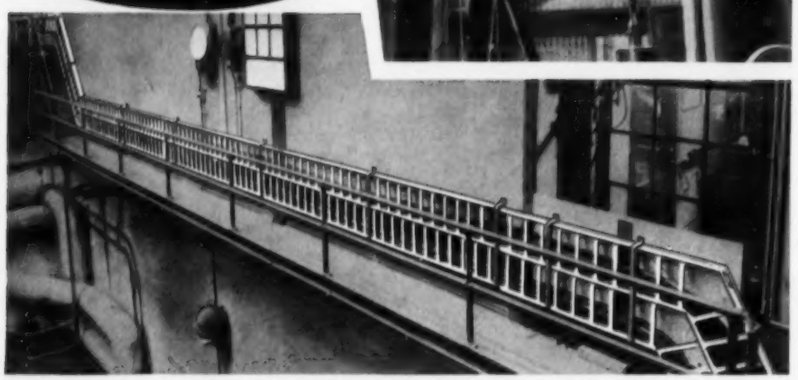

A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

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new bulletins

. . . circle key numbers on Read-N-Circle card, page 45

400-How to estimate building heat loss

Gas unit heater placement, thermostat location, and venting are covered in pocket-size Bulletin SA-571. Tables provide useful short cut for estimating heat loss in various buildings. Twenty pages. REZNOR MANUFACTURING CO.

401-Transformer data in pocket-size manual

Pocket-size booklet B-4716-B discusses transformer maintenance, inspection, classification, connections, methods of drying out. Provides handy summary of transformer care for maintenance personnel in industrial power plants, utilities. Fifty pages. WESTINGHOUSE ELECTRIC CORP.

402-How to get low cost brine

New bulletin gives useful tips on how to get low-cost saturated brine solution. Describes typical brinemakers for various applications. Includes useful brine tables for sodium chloride brine at 60 F. Twelve pages. MORTON SALT CO.

403-Specs on seamless titanium pipe, tubing

Size range, tolerances and mechanical, physical, and working properties of seamless titanium metal pipe and tubing are given in Bulletin TDC-185. Titanium is lightweight and corrosion resistant. Bulletin gives sizes, types, finishes, other useful data. Twelve pages. TUBLAR PRODUCTS DIV., BABCOCK & WILCOX CO.

404-Manual gives complete welding data

Catalog 57A is a comprehensive summary of electrode types for most welding applications. Data on each electrode type includes physical properties (as welded), typical chemical analysis of weld deposit, welding procedure, recommended current values, applications. Includes chart of approximate electrode requirements per foot of weld on common types of joints plus AISI SAE standard steel analysis tables. Catalog is indexed. Forty-two pages. THE CHAMPION RIVET CO.

405-Instrument transformer theory, operation

Instrument transformer theory and operation are discussed in Bulletin 61S8528. Fully indexed bulletin covers transformer function, types, polarity markings, insulation, impluse protection, accuracy. Includes useful ratio-phase angle correction chart. Twenty-four pages. ALLIS-CHALMERS MANUFACTURING CO.

406-How to choose liquid meters

Selection of meter-register for liquid metering jobs is simplified by charts in Bulletin 566. Describes meter sizes, construction details, register types, applications, installation. Twenty-eight pages. NEPTUNE METER CO.

407-Engineering data on diaphragm valves

Pneumatically operated diaphragm valves control liquid, gas, and steam flow. Bulletin S810-11-12 gives valve sizes, materials, plug characteristic curves, dimensions, cross section drawings. Valves are single- or double-seated. Eight pages. MINNEAPOLIS-HONEYWELL REGULATOR CO.

408-Charts simplify purifier selection

Selection chart in Bulletin 801 shows recommended purifier sizes at various steam flows for different pressures. Purifiers can separate solids and liquids from natural gas or eliminate condensate and oil from steam systems. Bulletin also describes freeze-proof steam traps, float traps, and self-cleaning strainers. Eight pages. THE V. D. ANDERSON CO.

409-Wall chart pinpoints diesel trouble spots

Useful 17 by 21 inch wall chart in Bulletin 983360 helps pinpoint common troubles encountered in diesel engine operation. Includes list of most common problems and their causes. Troubleshooting tips

include recognizing warning signs, reviewing previous repair and maintenance work for cludes. Eight pages. CUMMINS ENGINE CO., INC.

410-How to figure pipeline expansion

One-piece design of expansion joint eliminates usual bolted joint between body and gland. Bulletin EJ-1915 tells how to figure pipeline expansion, gives suggestions for expansion joint installation. Eight pages. YARNALL-WARING CO.

411-Performance charts on air source heat pumps

Compound compression-air source heat pump is described in new bulletin. Includes system diagrams, cost analysis and performance charts showing heat output and power consumption comparisons between conventional single-stage and multi-stage heat pumps. Twelve pages. YORK CORP.

412-Centrifuge separates, classifies, clarifies

Bulletin NC-104 describes Nozzle-Matic centrifuge for separating, clarifying, classifying, or concentrating liquid or liquid-solid moisture with high solid content. Centrifuge continuously discharges all phases, including solids. Flow charts show types of nozzle bowls available. Four pages. THE DE LAVAL SEPARATOR CO.

413-Data book describes lubrication fittings

Catalog gives individual dimensions of lubrication fittings, including pin type, hydraulic, and special-purpose fittings such as relief, measuring, and drive fittings. Includes data on bushings, elbow bodies, fitting extensions, plugs, tools, couplers, and nozzles. ALEMITE DIVISION, STEWART-WARNER CORP.

414-Air conditioners in 3- to 20-ton capacities

Bulletin 6125 gives details of package air conditioners in 3- to 20-ton capacities. Design features include spring-mounted hermetic compressor, extended-surface aluminum air filters for easy cleaning, hot gas muffler for quiet operation. Twenty pages. AMERICAN BLOWER DIV., AMERICAN RADIATOR & STANDARD CORP. ♦ ♦

Yarway Remote Hi-Lo Alarm Signals—lights or horns—can be used with Yarway Remote Liquid Level Indicator and placed at any location in the plant.

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*Write for free reprint of case description.

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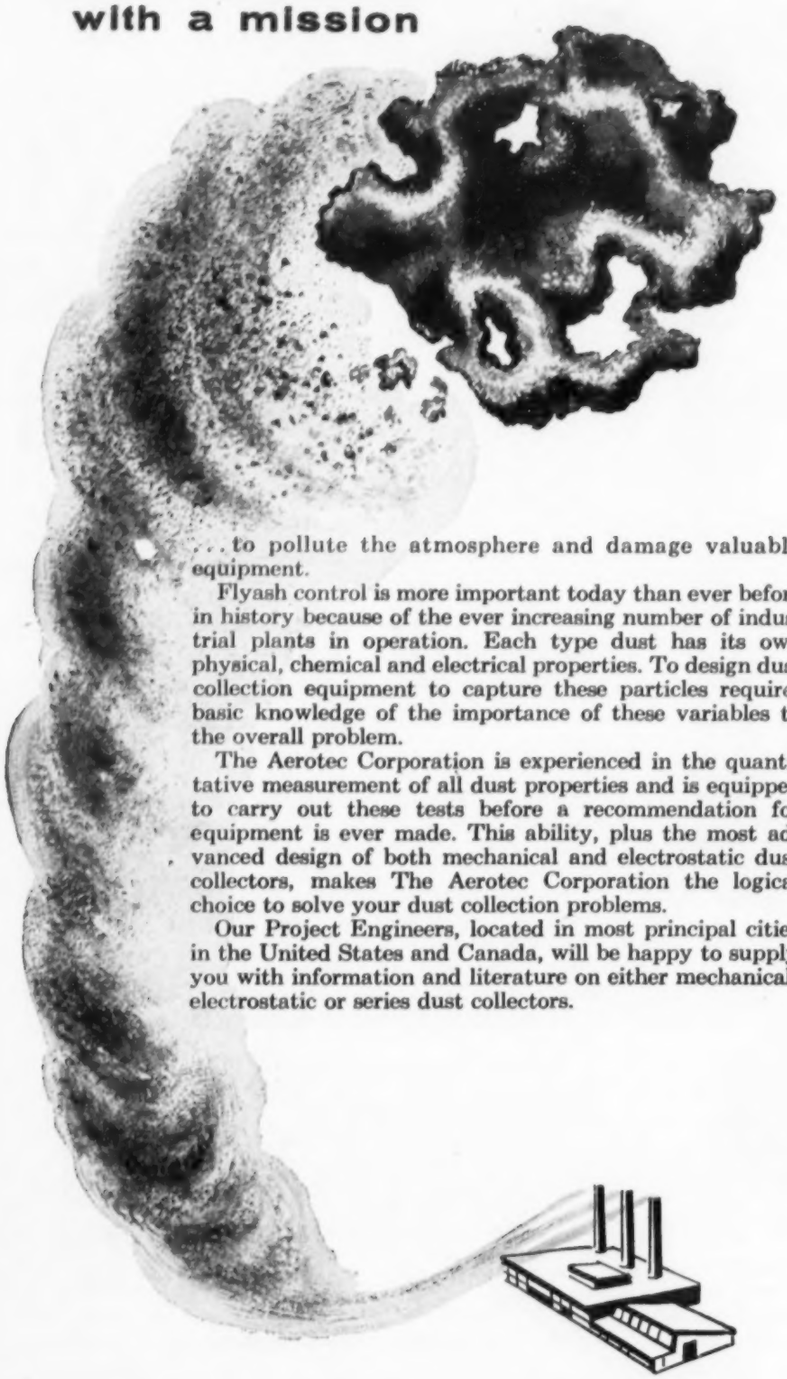

. . . to pollute the atmosphere and damage valuable equipment.

Flyash control is more important today than ever before in history because of the ever increasing number of industrial plants in operation. Each type dust has its own physical, chemical and electrical properties. To design dust collection equipment to capture these particles requires basic knowledge of the importance of these variables to the overall problem.

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Canadian Affiliates: T. C. CHOWN, LTD., 164 Metcalfe Ave., Westmount, Montreal 6, Que.

Manufacturers
THE AEROTEC CORPORATION
Greenwich, Conn.

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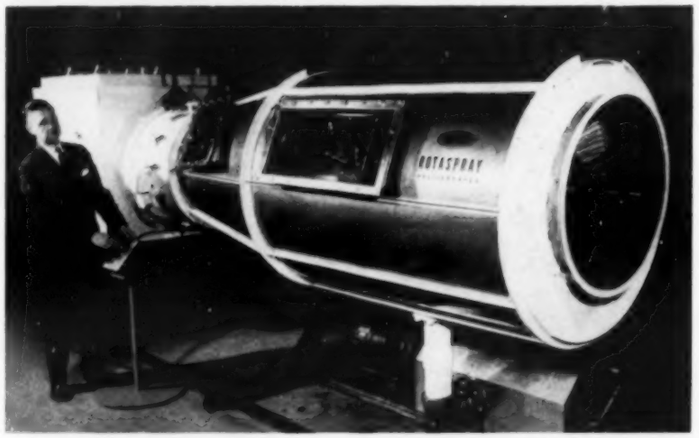
new products

. . . circle key numbers on Read-N-Circle card, page 45

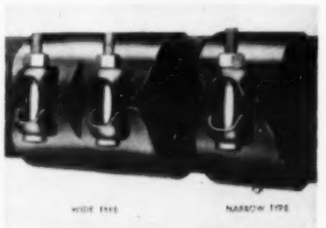
700-Air conditioner hangs from ceiling, filters lint and dust



Central air-conditioning unit uses one third the space of other units, can be installed on roof without shelter or suspended from ceiling. Unit draws air through cubically shaped mixing chamber. Air passes through spray of atomized water particles. Spin-dry eliminator removes water droplets, lint, other foreign matter before air enters duct system for distribution. Water carrying lint and dust drains to collection tank, where waste material is separated from water by moving-belt filter. Water is then recirculated to air conditioner. Spray nozzles have orifices capable of expanding to twice normal size to avoid clogging. Unit gives more accurate control of humidity than conventional models. Simplifies cleaning and maintenance where dust- and lint-laden air is a problem, yet unit is easy to install. CARRIER CORP.

701-Repair pipelines with pressed steel clamps

Clamp for repairing rust holes and corrosion spots in pipelines uses new design in which lugs are formed from



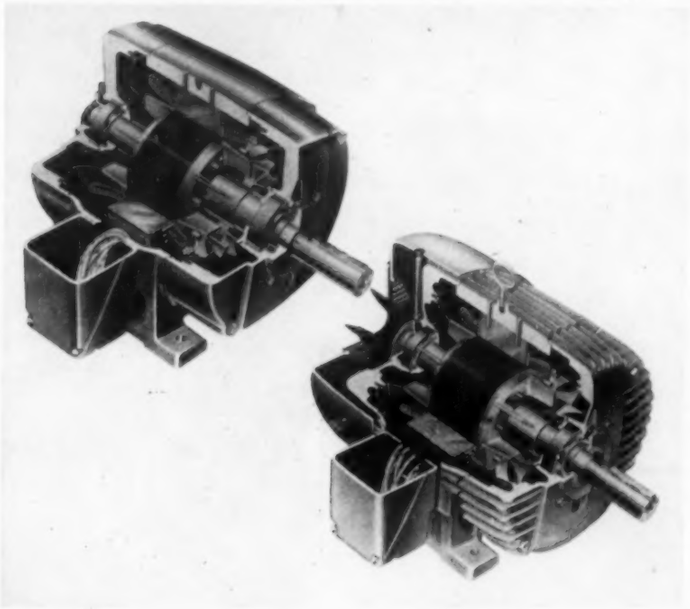
clamp material instead of being welded to clamp. Lugs and clamp are cold-formed on a 500-ton press. Clamps come in 4-inch and 8¼-inch widths. Sizes start at 4-in. od for all standard steel and cast iron pipe sizes to 24-in. od. Made of 3/16-in. stock for extra strength. M. B. SKINNER CO.

702-Clamps for quick cable installation

Clamps simplify cable installation because they can be used without first disassembling. Nuts are eliminated, so lineman can make installation without loose-part interruptions. Cover full range from No. 2 to 397.5 mcm in ACSR and from No. 2 to 400 mcm in

stranded aluminum conductor. Test currents produced conductor temperatures of 200 F without significant change in connection resistance. ALUMINUM CO. OF AMERICA.

703-Induction motors weigh 20% less, have new lube system



Standard line of induction motors from 1 to 125 hp have undergone first major redesign in 20 years. New motors weigh 20% less. Size, for comparable horsepower ratings, is reduced by 27%, chiefly by use of new insulation materials that are thinner and more effective. Improved lubrication system protects bearing housing from dirt yet allows regreasing when necessary. New line includes open dripproof motors or totally enclosed fan-cooled motors for corrosive atmosphere. New line is built to NEMA standards that give greater horsepower rating to a given motor frame size. Rating of 445U frame, for example, has been increased from 75 to 125 hp. Also run more quietly GENERAL ELECTRIC Co.

704-Whiteprinting machine reproduces 32 ft/min

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705-Temperature controller is mercury actuated

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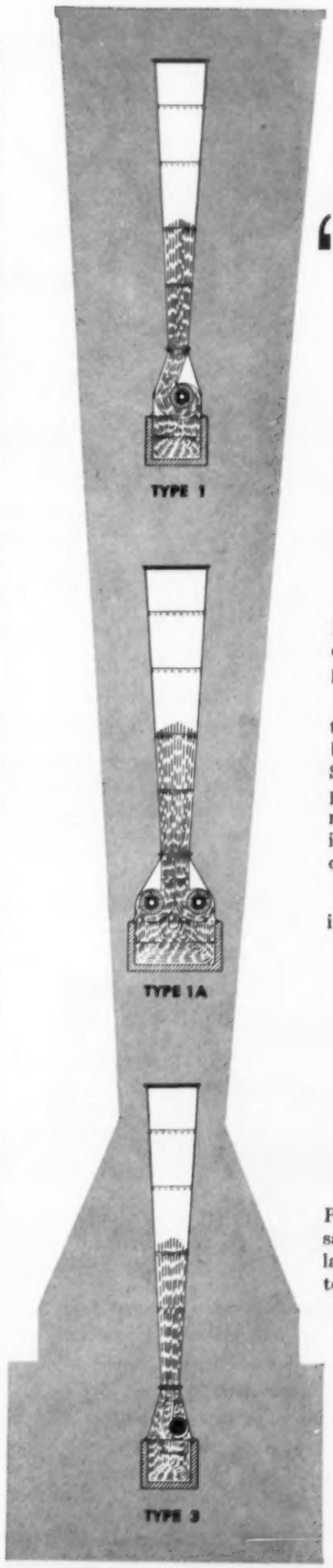
(more on page 28)



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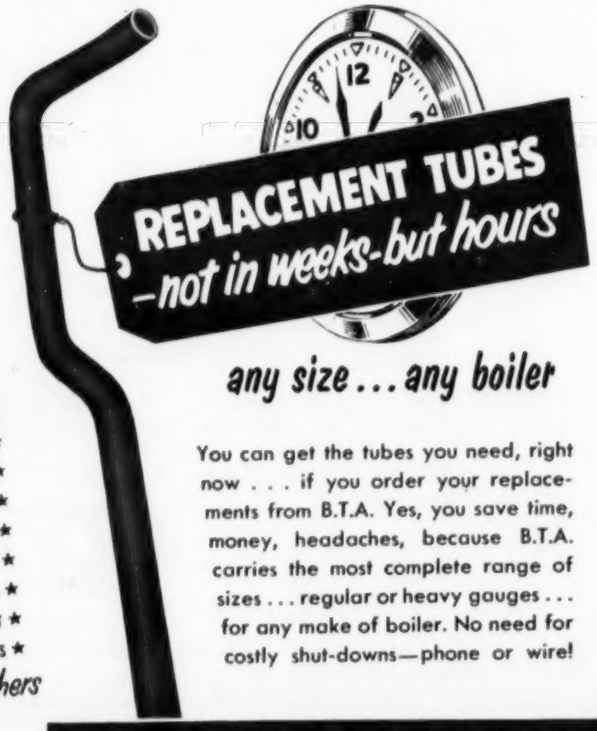
and others



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2B

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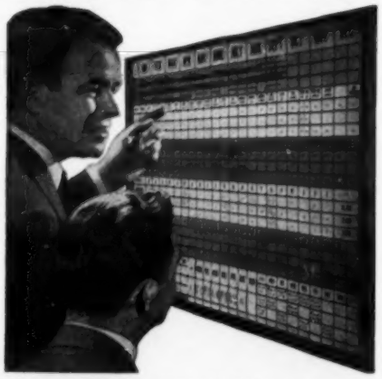

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new products

. . . starts on page 26

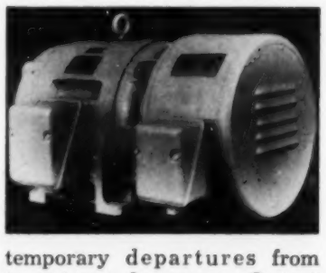
706-Car shaker simplifies unloading materials

Car shaker simplifies unloading materials from hopper bottom, open-top railroad cars. Loosens stubborn or frozen materials and starts rapid flow

from hopper openings. Action is produced by rotating an unbalanced shaft at 1800 rpm. Eccentric action is carried to car without going through any welded connections. Shaft is driven by 10-hp totally enclosed motor. EASTERN CONSTRUCTORS, INC.

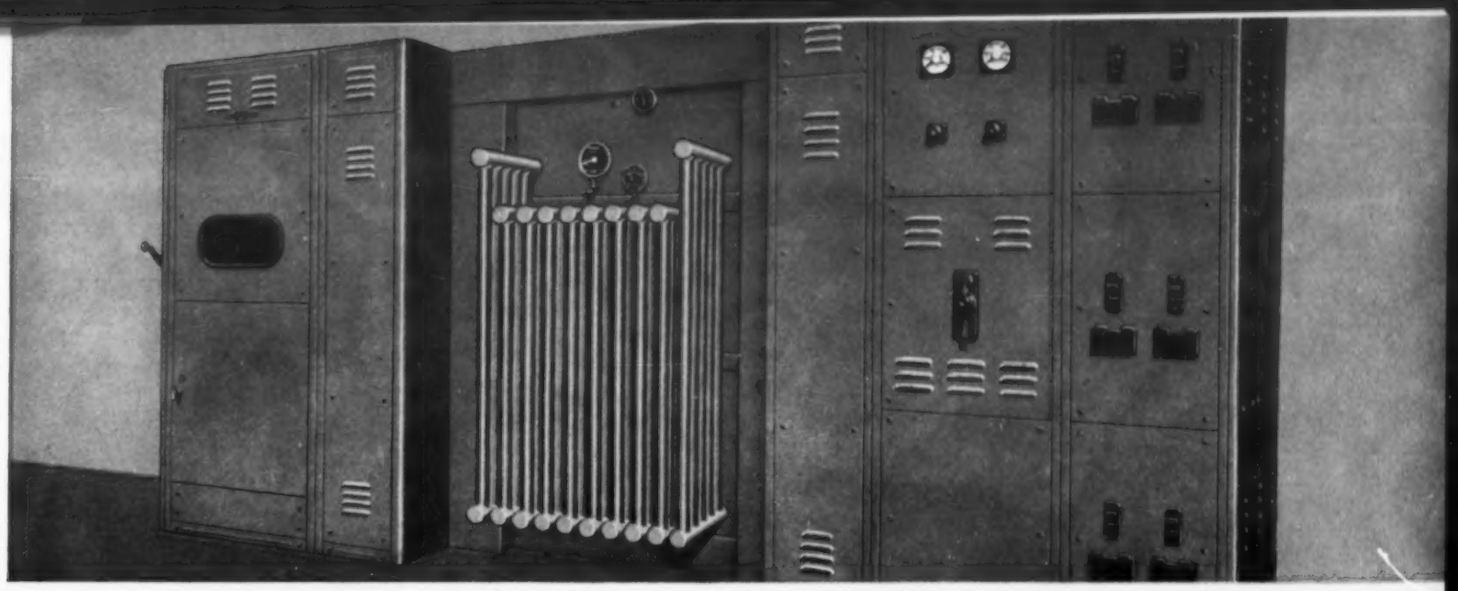
707-Brushless converter for exact 400-cps output

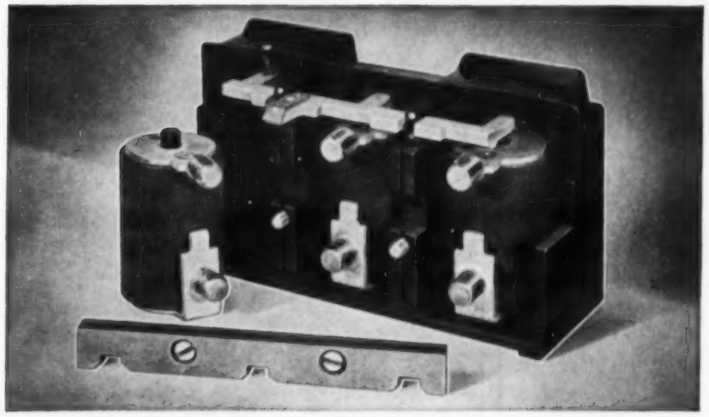
Brushless 400-cps converter unit uses 40-pole brushless generator, direct coupled to 1200-rpm, 60-cps synchronous motor. Generator is direct-mounted on motor. Inertia of motor rotor and flywheel construction give substantial flywheel effect, smoothing out



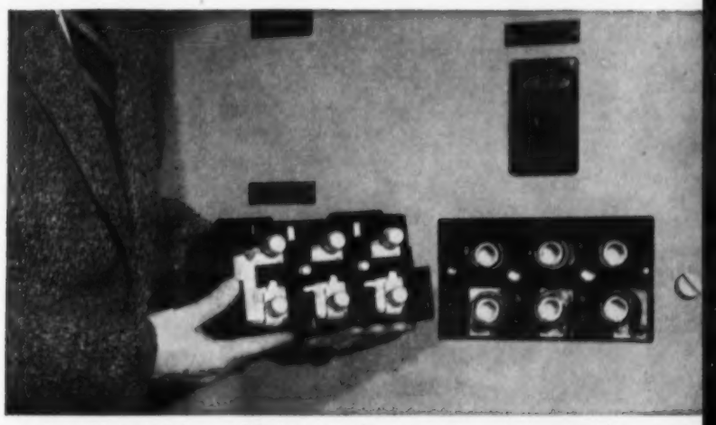
temporary departures from true input frequency. Output voltage with input variation as much as 15% remains within 1%. Any standard voltage, single or three phase, can be supplied. GEORATOR CORP.

(more on page 31)





Four frame sizes of the 100,000 RMS ampere IC rated "Cordon" current-limiting breakers are now available—100, 225, 400 and 600 amps; 600 volts AC; 250 volts DC.



Mounted in molded cases, the Amp-traps are accessible from the front of the substation for speedy replacement. Consult a BullDog field engineer for complete details.

Now... Unit substations with new "Cordon" current-limiting breakers

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Provide greater protection against high short circuits at less initial cost

Now, get the additional protection of this newly developed I-T-E Breaker in BullDog unit substations! "Cordon" current-limiting breakers protect circuits where fault currents may reach 100,000 RMS amperes . . . limit short-circuit currents of high magnitude to a fraction of their possible value. In one compact device they combine the advantages of standard thermal magnetic breakers with current-limiting characteristics of Amp-traps*.

These "Cordon" breakers bring real savings, too, since they can be used where more costly air breakers were once required. Amp-traps are mounted in a molded housing on the load side of the breaker. When any Amp-trap opens, all poles of the breaker open, thereby preventing possible single phasing.

Let a BullDog field engineer give you all the facts . . . show you the many safety and economy features of unit substations and complete BullDog electrical distribution systems.

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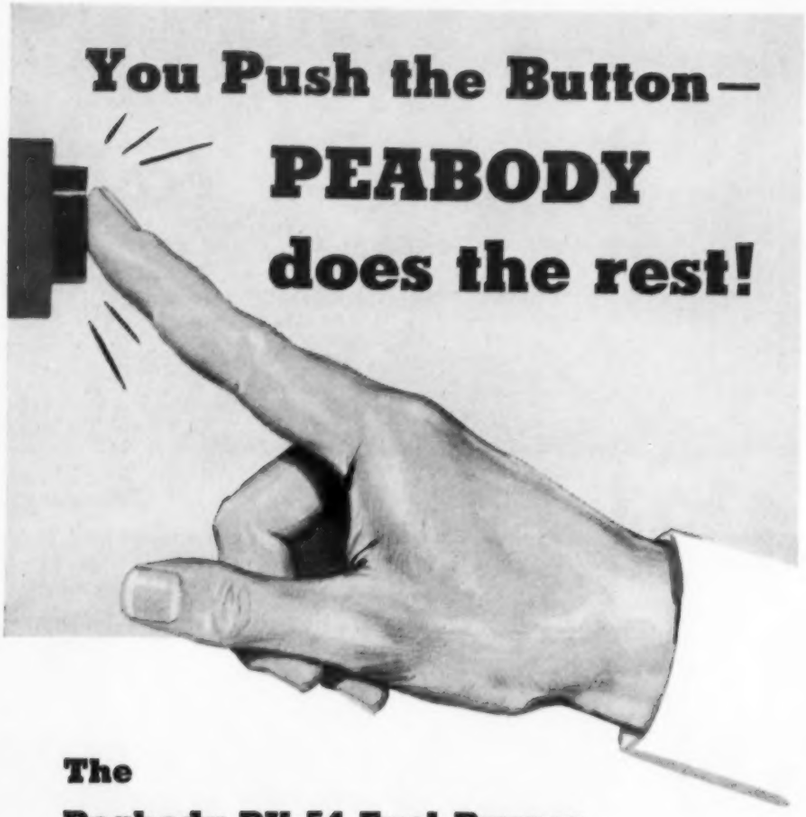
ELECTRIC PRODUCTS COMPANY

A DIVISION OF I-T-E CIRCUIT BREAKER COMPANY

*Trade-mark registered by Chase-Shawmut Company

You Push the Button— PEABODY does the rest!



The Peabody PK-54 Fuel Burner Automatically—

★ Maintains efficient combustion at all loads

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★ Purges the furnace before start-up

★ Follows the load demand

★ Shuts down if load ceases

★ Relights when load resumes, after satisfying all safety requirements

★ Shuts down and locks out on:
Flame failure
Combustion air failure
Atomizing steam failure
Excessive fuel pressure
Deficient fuel pressure
Deficient fuel temperature
Any preselected operating factor

This safe, efficient, dependable unit provides exactly what you need for your plant.

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Blow away . . . HEAT FATIGUE

model "56"

with *Aerovent* MANCOOLERS

model "6"

model "39"

"steeler"

According to medical authorities, workers in hot, oppressive plant areas are subject to "heat fatigue," which causes involuntary work slow-downs, mental depression, and, in some cases, actual illness. This means lowered production, loss of workdays, and costly employe "turnover."

Aerovent "Mancooler" Fans in strategic locations increase worker efficiency and comfort. This obviously results in greater production . . . a very profitable return from a reasonable investment!

Available with 2, 4 or 6 blades, in diameters from 24" to 48", and capacities to 40,000 CFM, there's an Aerovent "Mancooler" for every industrial application: cooling, ventilating, product drying and processing, or exhausting of heat or fumes.

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Heavy-gauge welded steel construction, with steel front and rear guards for maximum safety. (Rubber-tired wheels for Model 39 at slight extra cost.)

Rated in accordance with Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

Aerovent FAN CO. INC.
Ash and Boyd Sts. Piqua, Ohio

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new products

. . . starts on page 26

708-Adjustable-speed drives for 15- to 20-hp range

C-groove adjustable-speed drives have greater horsepower-transmitting capacity, per-

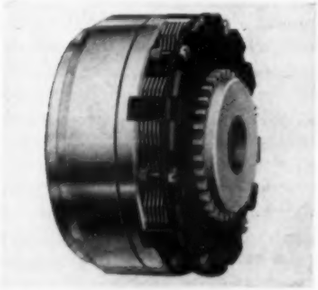
mitting use of 2 C belts to replace 4 or 5 B groove belts in 15- to 20-hp range with motor speeds of 1160 to 1750 rpm. New drives permit stepless speed adjustments to 26%. THE AMERICAN PULLEY CO.

MORE INFORMATION

For more detailed free information on these products just circle the key numbers on a READ-N-CIRCLE card on page 45 or 46.

709-Magnetic clutch gives complete torque control

Magnetic clutch has short axial and small radial dimensions, complete isolation of magnetic assembly from inte-



gral mechanical parts. Stationary field or brush types. Sizes from 2 to 13 inches for wet or dry operation. Clutch gives complete torque control under all rated conditions through pushbuttons, relays, or limit switches. FAWICK CORP. ♦ ♦

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INCREASED PRODUCTION *with* GREATER FUEL ECONOMY

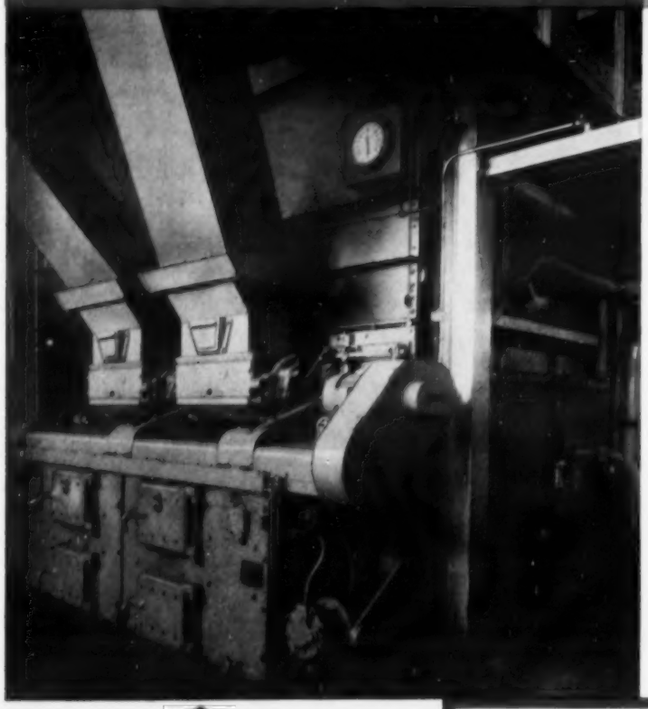
Smokeless Operation

DETROIT ROTOSTOKER TYPE C-C

(Continuous Cleaning)

at Carlisle Tire and Rubber Division

CARLISLE, PA.



It is not uncommon for the Detroit RotoStoker, Type C-C to make fuel savings ranging from 10% to 25%. Where process steam is used in production, as in this plant, fuel economy is usually accompanied by a substantial production increase.

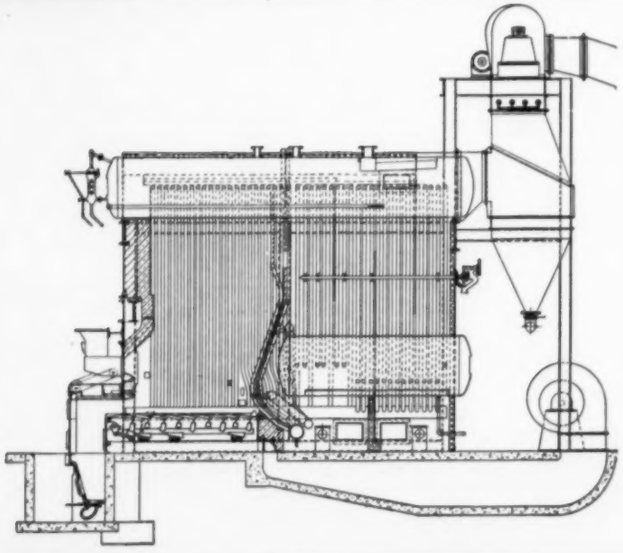
In addition the Type C-C provides smokeless operation at light loads as well as at full capacity—important in built-up areas.

Other advantages of Type C-C are:

- **Continuous uninterrupted steaming.**
- **Ample capacity and high availability.**
- **Quick response to load fluctuations.**
- **Fuel feeders and distributors handle high moisture coals without clogging.**
- **Available to develop 5,000 to 75,000 lbs. of steam per hour.**
- **Easily applied to new or existing boilers.**
- **Low Maintenance.**

Detroit RotoStoker Type C-C (continuous cleaning) in the plant of Carlisle Tire and Rubber Division of Carlisle Corporation. This unit has a capacity of 25,000 pounds of steam per hour. Either West Virginia or Pennsylvania 13,500 BTU coal is used.

Keeler Type CP Boiler with Detroit RotoStoker Type C-C. Ashes discharge at front, are removed by a conveyor. No basement is needed.



DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS
MONROE, MICHIGAN

Branch Offices or Representatives in Principal Cities

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Management skills

. . . starts on page 13

their material wants and desires, but also to satisfy a whole range of psychological and ethical expectations. Most of these expectations are basically reasonable, and it is the responsibility of the manager and all his associates to recognize them.

I have no sure-fire prescription to offer at this juncture. It would seem to me, however, that the ultimate solutions will develop along these lines.

First, we in industry—managers and non-managers — will have to become far more sensitive to the social and political currents and undercurrents in this country. We will have to become students, humbly seeking to know more about the economic, political, and ethical principles that vitalize this new "people's capitalism." We need to develop a greater feeling for the human considerations that loom so large in the final outcome of all our efforts. When we have developed this greater sensitivity and knowledge, we can be more confident that our decisions and actions are what we earnestly want them to be — in the balanced best interest of all.

Second, we businessmen need to study the future. America is undergoing profound change and growth. The company that does not anticipate these changes and plan accordingly is going to find itself like a fish out of water, in a strange and hostile environment. We must anticipate the major social, political, and economic trends and help to shape them. We must also help the public understand these changes and make choices that are in their own best interests.

Businessmen cannot afford the luxury of standing quietly on the sidelines while others lead America down the "something-for-nothing" trail toward a more regimented and socialized society. We must construct our own, more appealing vision of the future — a future which increases human dignity, human freedom, and human achievement.

Third, we need to "do right

voluntarily." We can hardly expect to have either self-respect or public support if our own actions betray mean motives, shallow minds, or double standards. I heartily resent the insults of those who imply that a businessman is, by definition, a ruthless creature who has sold his soul for money and power. But every time one of us makes an expedient or selfish decision, we feed this antique prejudice. If we make mistakes, as we will, let us have the grace to admit them and try to undo the damage. Mistakes will be forgiven if the people are convinced that we are trying to follow, as Lincoln put it, "the better angels of our nature." This inward integrity is what we expect of other men, and it is what they expect of us.

Fourth, we in business need to learn to communicate our convictions and aspirations. Why do we so often remain silent while our company, or our industry, or the entire business community is subjected to irresponsible attack? Why do we allow a few noisy demagogues to turn businessman against businessman, to grab off credit for our achievements, or to undermine the very foundations of public confidence? Have we so few ideas? Have we so little to speak about? Or are we simply afraid to take them on in the battle of ideas? The new responsibilities of the professional manager include the responsibility to make his opinions heard, understood, and believed in the arena of public opinion. This responsibility is shared by other employees, but the manager must provide the leadership.

And finally, we in business need to learn how to be politically effective. Government is becoming a more significant factor in business decisions with every passing year. The pressure groups that are trying to squeeze more than their share out of the proceeds of business are turning increasingly to politics.

There is a whole new field to be explored in this matter of discovering and organizing the political resources of business. Perhaps in the past the manager has not felt that this was a part of his assignment. It is now. ♦ ♦

Unretouched photo shows what happens when a boiler feed line is clogged with calcium carbonate deposits. CAUSE: *lack of chemical stability in feed water.* REMEDY: *properly balanced water treatment.*

LINE OF MOST RESISTANCE

A heavy build-up of scale, like that shown in the illustration, will gradually reduce the effective diameter of feed line piping, and will result in seriously restricted carrying capacity.

The line must be shut down for maintenance or replacement, causing expensive down time in the plant. Proper water conditioning will prevent this unnecessary loss. This is but one of the many problems presented by the corrosive elements of water.

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Dearborn Supervisory Service provides you with the three elements necessary to maintain the best in a water conditioning program—positive control, top performance effectiveness and maximum economy.

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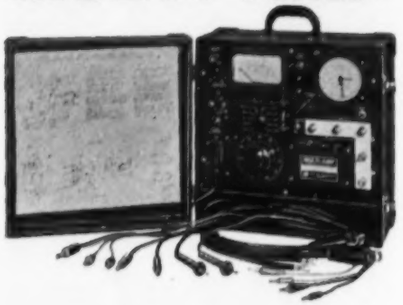
COMPACT, HIGH CURRENT

TESTING INSTRUMENTS

FOR PROTECTIVE DEVICES

TO COMPARE WITH MULTI-AMP®



MULTI-AMP patented instruments are recognized as models of efficiency, dependability and compactness.

MULTI-AMP test instruments test and calibrate a wide range of electrical equipment such as protective relays, overload relays, switch gear devices, circuit breakers, fuses, etc., for highest possible protection against power outages and fire.

MULTI-AMP test instruments are safely isolated from the line . . . and utilize low voltage, high current transformer loading.

Specially built MULTI-AMP test instruments in large numbers have been produced for such firms as:

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Test instrument shown is Multi-Amp Model 1004/44/61-V, O.4 KVA continuous duty. Current output: 0-100 A-4V; 50A-8V; 25A-16V; 12.5A-32V. OUTPUT VOLTAGES. 0-150/300/600/1200 VOLTS at ¼ Amperes. For additional information request data sheet #1756.

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Conservation

. . . starts on page 16

sary steps to insure maximum utilization of heat energy put into steam at the power stations. One very important aspect of this endeavor is the maintenance of an optimum steam-electric power balance throughout the refinery.

Steam is produced at 1350 and 400 psig, and distributed to the refinery at 400, 100, and 10 psig for process use. Practically all electric power required in the refinery is generated as a by-product of steam production. Turbogenerator units are 1350-400 psig, 1350-100 psig, or 400-100 psig machines, with three small units available for operation between 100 and 10 psig. Two of these small units are arranged for alternate operation between 100 psig and atmosphere.

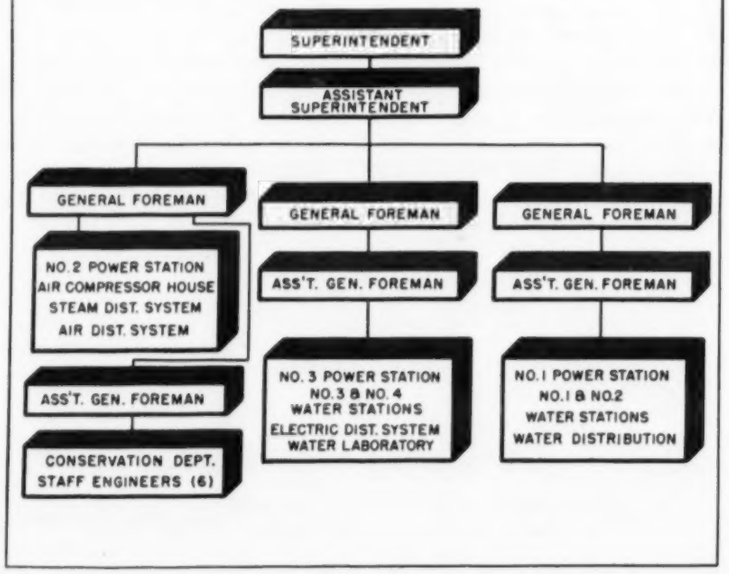
Refinery steam demands at the various pressures in excess of supplies from the turbogenerators are made up by using pressure reducing stations. Highest steam loads occur in the winter because of large heating demands. Alternate condensing turbine drives are available on water pumps in place of motor drives. In summer, these can be used to create steam demand if it has fallen below that necessary to produce refinery power on a by-product basis.

To assure continuity of refinery process unit operations, many process pumps and other pieces of refinery equipment have steam-turbine driven spares. These turbines operate mainly between 100 and 10 psig. A certain number of these spares are usually in operation because normally motor-driven equipment is down for maintenance. Because of low steam demand in summer, operating these spares can create a surplus of low-pressure steam, which at times must be vented to atmosphere. The Conservation department makes a weekly check on drives that are in operation on the refinery units. Conservation engineers point out to process operating personnel the daily losses that occur when operation of spare equipment contributes to steam wastage to atmosphere. This action provides an incentive for expediting maintenance work.

Conservation department engineers work closely with design engineers when new process or utility units are being planned. In this way, the steam-electric power balance is maintained or improved.

A refinery process unit currently in design will have a large blower driven by a mixed-pressure turbine that has throttle steam conditions of either 400 or 100 psig and exhaust conditions of either 100 psig or vacuum. With this machine, it will be possible to use more by-product power capability of the utility systems throughout the year by reducing loads on pressure reducing stations in winter. In another case, a decision was made to air condition a new office-laboratory building using absorption cooling rather than compression equipment. This absorption unit gives a summer demand for 10-psig steam while the compressors, in requiring additional electric power, would have a deleterious effect on the situation.

ORGANIZATION OF UTILITIES DIVISION



conservation department studies economics

Steam conservation engineers are in large part responsible for saving steam in another important manner. Boilers are operated on essentially 100% makeup and feedwater is heated to 240 F in the first stage of water treatment by intimate contact with 10-psig steam. During winter, a saving in steam represents a material reduction in operating costs. At many locations in the refinery, cooling water in process units is heated by indirect exchange with the process streams to temperatures of 175-200 F. Working with utility design engineers, the Conservation department determines the economics of collecting this hot water and pumping it to the power station as raw water for the feedwater treating plant. Here again, the department makes recommendations to the Engineering departments with regard to savings that may be realized in designing new refinery units.

On a new crude unit, a recommendation to raise the outlet cooling water temperatures on certain exchangers (adding chemical treatment to avoid scaling) was adopted. Savings of $120,000/year, resulting from higher feedwater temperature to the power stations, have been accomplished.

An extensive hot water collecting system has been constructed over the years and the Conservation department is responsible for its efficient operation. Some steam condensate is returned to this system from

Combustion engineers check all refinery furnaces at least once a week, carrying out both visual examination and flue gas analysis.

such sources as process exchangers. This available steam condensate is a very small portion of the total steam generated for refinery use, however.

A counterpart to seeking the hottest water from process exchangers for boiler feed is the search for lower-than-necessary temperatures leaving process units. Correcting these conditions gives savings in water pumping costs and conserves pumping capacity. Observance of normally low temperature on a large quantity of water from one process unit over a long period of time led to a recommendation by the Conservation department for reuse of this water on new units instead of building cooling towers. This recommendation has been used in the design of the new units and is expected to save $\$3/4$ million in investment and $125,000/year in maintenance costs.

Final phase of steam conservation work might be described simply as good police work. Each of three conservation engineers is assigned a third of the refinery area, in which he is responsible for eliminating steam waste. He studies steam flowmeter charts for evidence of abnormal usage. He patrols the area on a motor scooter looking for evidence of steam escaping or improper operation of steam equipment. He investigates any reports from others on difficulties with steam service. These methods have proven quite successful in locating and stopping such wastes as:

- Broken or faulty traps
- Open-free blow valves
- Failure to turn off steam to steam hoses
- Open cross-connections between high- and low-pressure steam headers
- Steam drives exhausting to atmosphere instead of to 10-psig system during winter.

Since any large steam waste must be reflected on the daily flowmeter charts, these charts are the most important source of conservation information. Typical examples of the type of waste prevented are:

- Charts indicated a night-time flow to tank car cleaning racks not being used. Investigation showed a large number of steam hoses were not being properly blown out and racked-up at night. They were kept from freezing by allowing steam to bleed through them all night. The conservation engineer showed the men on the rack the meter charts and explained how much this steam costs. Co-operation from these men in properly storing the hoses saves $120/day.
- A 100-psig flowmeter chart

(continues on page 36)

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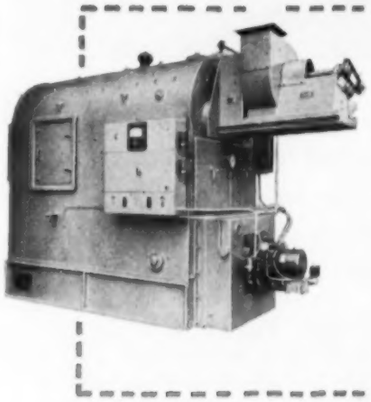

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A fully coordinated factory fire-tested unit, complete with all necessary controls and combustion equipment for automatic operation.

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BOILER-BURNER UNIT

. . . combining the outstanding performance features of an International boiler with a nationally approved burner delivered separately, installed and serviced by a qualified local distributor.

Both give you the same outstanding advantages and economies of International water tube boiler design . . .

- **Ample Furnace Volume—low heat release rates**
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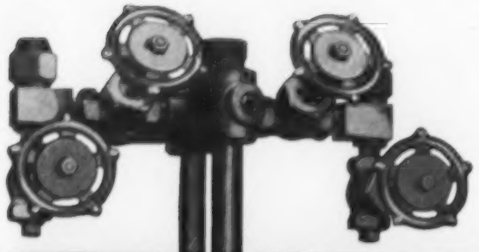
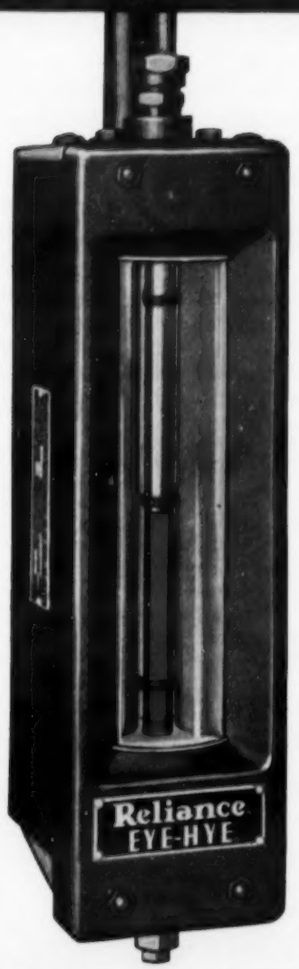


Models for panel or wall mounting

"Wouldn't operate my plant without them" says St. Louis engineer, of his

EYE-HYE® Remote Reading Indicators



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Here is easy natural reading (like conventional water gages) with perfect measurement and constant dependability. Twenty years on the market, and still increasing in use, here and abroad.

Simple as A-B-C, EYE-HYE indicates water level clearly by illuminated green fluid. Newly styled face plate gives wider angle of vision. And for extra safety, optional equipment adds auxiliary light signals and/or vibratory horns, reaching operators anywhere.

EYE-HYE serves main boilers — any pressure — and various power plant tanks and vessels in out-of-the-way places. Two EYE-HYEs are now acceptable under Boiler Code Case No. 1155 — eliminate maintenance of extra gage glass.

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The Reliance Gauge Column Company • 5902 Carnegie Avenue • Cleveland 3, Ohio

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Conservation

. . . starts on page 16

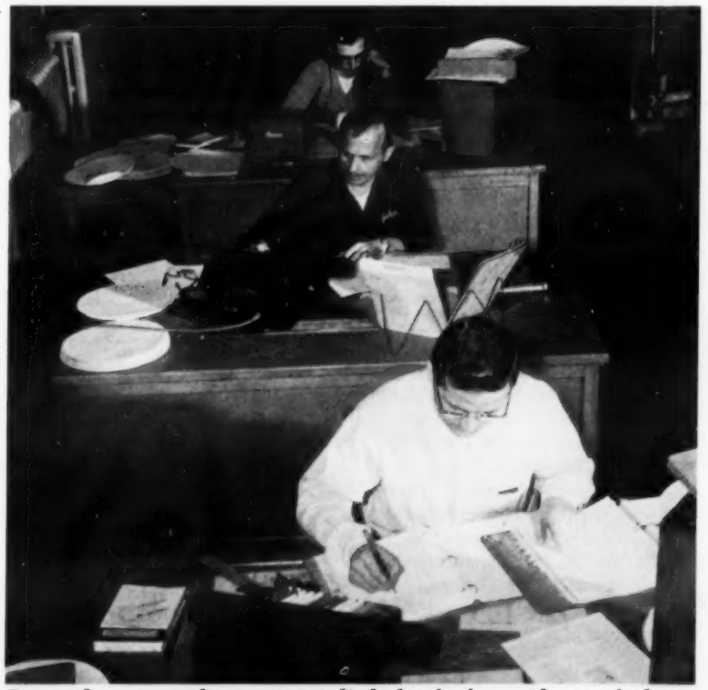
indicated abnormal flow to a process unit. Investigation showed that a 2-inch cross-connection between the 100- and 10-psig systems had been improperly opened. Steam at 100 psig was discharging to the 10-psig system at a cost of approximately $50/day.

- A 10-psig chart indicated abnormal flow from another process unit. The conservation engineer found the turbine governors on the dual-driven pumps improperly adjusted. After the machinists had readjusted the governors, the 10-psig exhaust steam flow was reduced. Savings in excess of $200/day were effected.
- A check of the valve timing on the steam-driven compressors in one large process unit, by taking indicator cards, resulted in savings over $28,000/year adjustments.

Basically, duty of combustion engineers is to maintain efficiency of each process furnace in the refinery as near as possible to that established during its performance tests. Combustion engineers check most refinery furnaces at least once a week, including both visual examination and flue gas analysis. They are responsible for maintaining proper adjustments of air registers and stack dampers. Unit operators are encouraged to change these adjustments only if absolutely necessary. If changes must be made, the Conservation department must be notified as soon as possible so that the furnace can be rechecked. Any needed repairs to the furnace are noted and reported at the next shutdown. Such repairs are normally checked by conservation engineers before the furnace is placed back in service.

Refinery furnaces burn fuel oil, refinery gas, and "dump" gas from a public utility. Another duty of the combustion engineers is maintaining the necessary equilibrium between oil and gas usage.

Only by such constant police work can a modern plant insure that its power services costs are as low as possible. Only by sound conservation practices in all its departments can a company hope for future growth. Only by earnest competitive initiative and example can a genuine desire for high-level conservation be sustained throughout the industry and the country as a whole. ♦ ♦



Steam flowmeter charts are studied closely for evidence of abnormal steam usage as part of day-to-day conservation police work.

TABLE I — MAXIMUM ALLOWABLE OVERALL PLANT DIMENSIONS

Two Boiler Plant Capacity	Oil and Gas-fired Boilers (Fig. 1) Height H	Width W	Length L	Field Erected Coal-fired Boilers (Fig. 2) Height H	Width W	Length L	Package Coal-fired Boilers (Fig. 3) Height H1	Height H2	Width W	Length L
20,000 lb/hr	19 ft	31 ft	57 ft	36 ft	48 ft	60 ft	19.5 ft	29.75 ft	30.5 ft	46.25 ft
30,000	19	34	57	36	48	62	19.5	29.75	33.5	46.75
40,000	19	37	57	36	48	64	19.5	29.75	36.5	47.25
50,000	19	40	57	36	48	66	19.5	29.75	39.5	47.5
60,000	19	42	57	36	48	68	19.5	29.75	42.5	47.5
70,000	19	43	57	36	48	70	19.5	29.75	45	47.5
80,000	19	45	57	36	48	72	19.5	29.75	47	48
90,000	19	46	57	36	48	74	19.5	29.75	49	48
100,000	19	48	57	36	48	76	—	—	—	—
Three Boiler Plant Capacity										
90,000 lb/hr	19 ft	50 ft	57 ft	36 ft	48 ft	78 ft	19.5 ft	29.75 ft	50.5 ft	46.25 ft
30,000	19	53	57	36	48	81	19.5	29.75	53.5	46.75
45,000	19	56	57	36	48	84	19.5	29.75	56.5	47.25
105,000	19	59	57	36	48	87	19.5	29.75	59.5	47.5
120,000	19	61	57	36	48	90	19.5	29.75	62.5	47.5
135,000	19	62	57	36	48	93	19.5	29.75	65	47.5
150,000	19	64	57	36	48	96	19.5	29.75	67	48
60,000	19	65	57	36	48	99	19.5	29.75	69	48
75,000	19	67	57	36	48	101	—	—	—	—

equipment should be provided for measuring boiler water concentration, dissolved oxygen in feedwater, and pH of returns. External water softeners are required where makeup water analyses dictate such treatment.

To determine which type to build, *calculate* the relative economies of all three, as outlined in INDUSTRY POWER, September 1956. The same reasoning applies to the various modifications that can be applied to each of these plants. Don't just buy (or not buy) that equipment — calculate the relative economies first. ♦ ♦

Military specification MIL-B-17095B is available from the U. S. Government Printing Office, Superintendent of Documents, Washington 25, D. C.

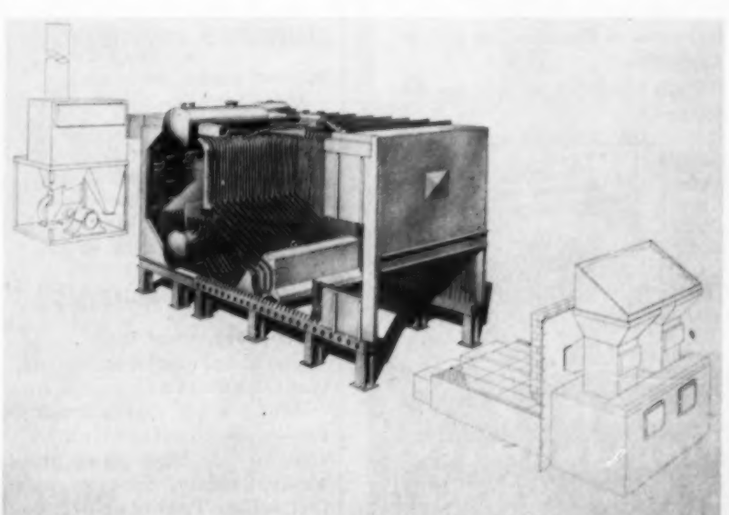


Fig. 4—30,000 lb/hr coal-fired package boiler comes in three parts—stoker, boiler, and dust collector (which may be omitted if desired).

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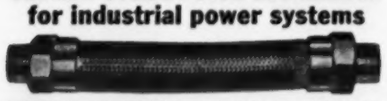

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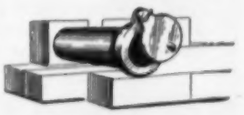

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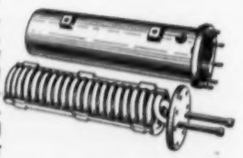

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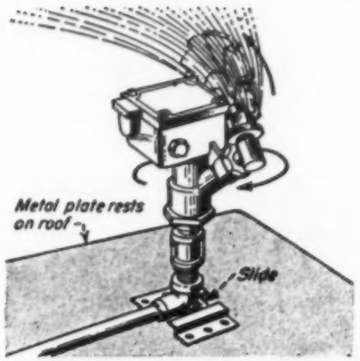
(more on page 40)



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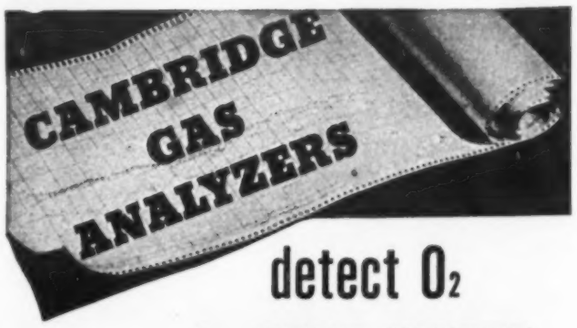

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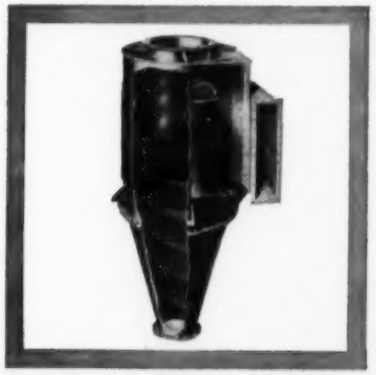

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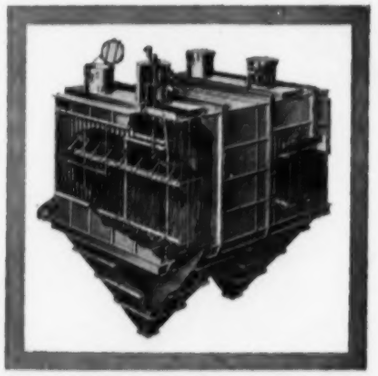

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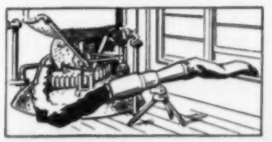

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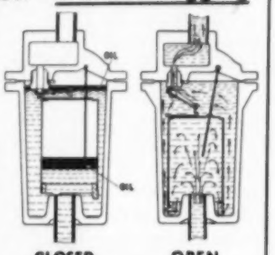

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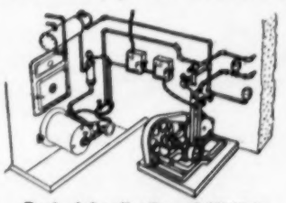

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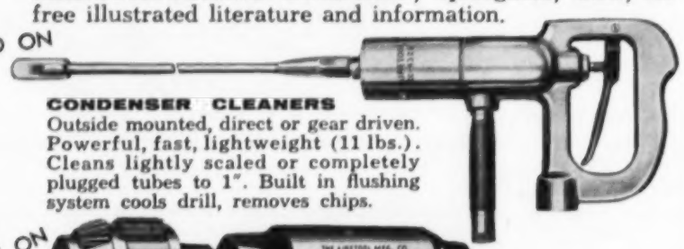

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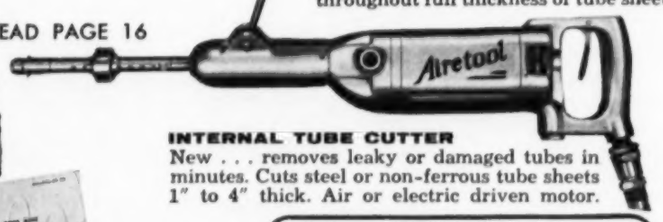
SEE PAGE 18

CONDENSER TUBE EXPANDERS
Parallel rolling—self feeding—Airetool Tube Expanders roll right, accurate tube joints with maximum bond, uniform expansion and tightness throughout full thickness of tube sheet.

READ PAGE 16



INTERNAL TUBE CUTTER
New . . . removes leaky or damaged tubes in minutes. Cuts steel or non-ferrous tube sheets 1" to 4" thick. Air or electric driven motor.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

Write for illustrated Airetool Bulletin No. 60, showing complete line of Airetool Tube Maintenance equipment plus Airetool Specialty tools . . . Airetool's new, light-weight, air-motor grinders . . . and Airetool's Automatic Expansion Control System.

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge
REPRESENTATIVES in principal cities of U. S. A., Canada, Mexico, South America, England, Europe, Puerto Rico, Japan, Hawaii.
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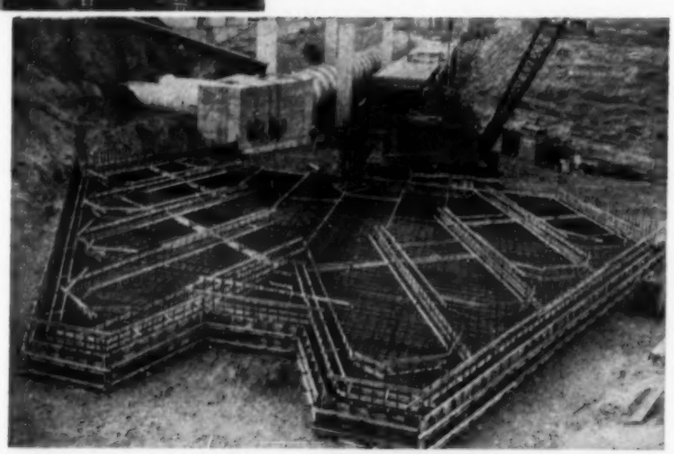
Circle 115 on READ-N-CIRCLE card for more data

Industry Power's

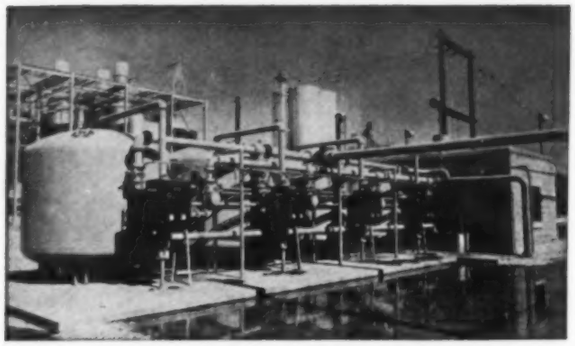
News in Photos

John Ware, Philadelphia industrialist (far right), receives "Rags to Riches" award from General David Sarnoff, Chairman of RCA. Chairman of the board of Northeastern Water Co., and American Water Co., Ware is first in the utilities field to win the coveted Horatio Alger Award of the American Schools and Colleges Association. Previous winners were former President Herbert Hoover, Bernard Baruch, Dr. Milton Eisenhower, Charles E. Wilson of General Electric, J. C. Penny, and Eddie Rickenbacker.

Scientist guides uranium fuel component into reactor core of Atomics International's Sodium Reactor Experiment (SRE) during experimental fuel loadings. Reactor is part of AEC's program to develop economical power from atomic energy. Located near Los Angeles, reactor went into operation in April.



▲ Fan shaped figure, is base of pumpwell for Southern California Edison's new steam generating plant, being built near Huntington Beach, Calif. Plant will have ultimate rated capacity of 400,000 kw. Pumpwell will provide millions of gallons of water needed to cool condensers of twin turbogenerators. Two 14-foot dia conduits will reach some 350 feet into the Pacific to collect cooling water.



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(for over half a century)

Complete plants for water softening, demineralization, silica removal, de-oiling of conrensate, clarification, de-alkalizing and all other requirements.

Send for Bulletin BFT-11
or Nearest Field Representative.

HUNGERFORD & TERRY, INC.
CLAYTON 1, NEW JERSEY

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MERCOID
DIFFERENTIAL PRESSURE CONTROLS

Equipped with HERMETICALLY SEALED Mercury Contacts

TO "MAKE" OR "BREAK" AN ELECTRICAL CIRCUIT ON CHANGES IN THE DIFFERENCE BETWEEN TWO PRESSURES

← FOR HIGH PRESSURES
Bourdon Tube Operated

Series BB: Operating ranges from 0-60 psi to 2,500 psi., with sensitivities varying from 0.4" to 50 psi.
Write for bulletin No. 15

← FOR LOW PRESSURES
Diaphragm Operated

Extremely sensitive, for air or gas. Series PQ: Operating ranges (inches of water) 6.0" vac. to 6.0" press. (sensitivity .03",) and 30.0" vac. to 30.0" press. (sensitivity 0.1" to 0.02").
Write for Bulletin No. 14

THE MERCOID CORPORATION
4201 Belmont Avenue, Chicago 41, Illinois

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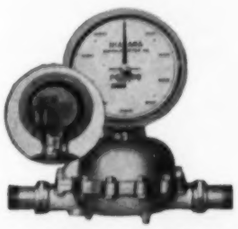
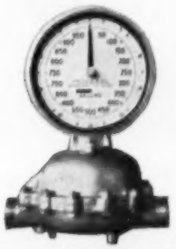
NIAGARA LIQUID METERS

- **Standardize Quality**
- **Aid Cost Control**
- **Promote Efficiency**

Niagara Chemical Meter with set-back register.



Niagara Electricontact Meter with explosion-proof microswitch.



Niagara Oil and Specialty Meter with 10" dial.

Niagara Liquid Meters contribute to the quality and uniformity of your product, because they do more than measure. They help to maintain consistent and accurate cost. They reduce waste and thus promote efficiency.

In hundreds of applications they prove their versatility of use. To name a few: Niagara Chemical Meters measure and control use and processing of most liquid chemical solutions. Fuel Oil Meters measure oil burned in boilers and permit oil consumption to be compared with the water evaporated to determine boiler efficiency. Syrup meters control this vital ingredient as used in candy or ice cream. Hot water meters measure water used, condensate returns or boiler feed water. Even cold water metering is highly profitable by avoiding waste in the control of batch measurement or processes using cold water. In each case the Niagara Meters are monitors of quality or cost control, not just recorders of the number of gallons passed through them.

Let us tell you what Niagara Displacement Type Liquid Meters can do for you. Write us or use coupon below for prompt reply.

Send me information on automatic use of Niagara Meters based on the following:

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Temp._____ ° F. Pressure_____ p.s.i.

Flow rate_____ g.p.

Max. batch_____ gals.

☐ Have representative call.

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*Address*_____

*City*_____ *State*_____

BUFFALO METER CO.
2933 Main Street
BUFFALO 14, NEW YORK

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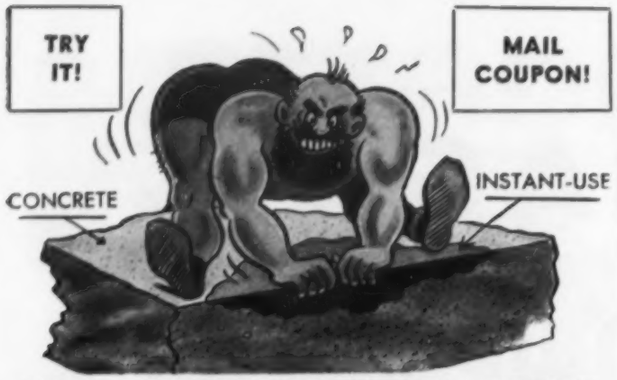

THIS TOUGH CONCRETE PATCH SETS INSTANTLY!

Repair broken factory floors without the usual traffic tie-up. Simply shovel INSTANT-USE into hole or rut—tamp smooth—truck over! No waiting! INSTANT-USE bonds tight to old concrete—right up to a feather edge. It's tough. Wears like iron. Won't crack or crumble. Install complete overlay where floors are badly chewed up. Used indoors or out. Immediate shipment.

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INSTANT-USE

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3605 Filbert St., Philadelphia 1, Pa.

Please send me complete INSTANT-USE information, details of TRIAL ORDER PLAN and Free INSTANT-USE BROCHURE—no obligation. (Clip and attach Coupon to Company letterhead.)

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Company.....
Address.....

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names

. . . in the news

Iron Fireman Manufacturing Co. elects **Orval D. Berry** vice president. He is manager of Electronics Div.

American Gilsonite Co. elects **Roy E. Nelson** vice president. He is credited with developing Gilsulate® for insulating hot underground pipelines.

Infilco Inc. elects **J. S. Gustafson,** former executive vice president, president. **P. N. Engel** is board chairman.

Worthington Corp. elects **Walther H. Feldmann** president, succeeding **Edwin J. Schwanhausser,** new board vice chairman. **Hobart C. Ramsey** is board chairman.

Department of Commerce appoints **Eubert F. Tagger** director, Electric Equipment Div., Business and Defense Services Administration. ♦ ♦

CHEMICALS vs EQUIPMENT

Why the Wrangle About Water Treating?

Let's face the facts. In many cases, chemicals alone can do an excellent job of treating water. In other cases, equipment is justified by results and operating costs. And many times, a combination of equipment and chemicals is the answer.

Elgin is wholly unbiased because we supply all types of water treating chemicals and water conditioning equipment.* Backed by our half-century of experience, your nearest Elgin representative can make recommendations based squarely upon your specific needs. And Elgin's reputation for follow through service to users assures complete satisfaction.

For facts, write for bulletins . . . or, better still, let us put you in touch with our nearest representative.

ELGIN SOFTENER CORPORATION
ESTABLISHED 1908
138 N. Grove Ave., Elgin, Illinois

*Manufacturers of Water Treatment, Feeders, Testing Equipment, Zeolite Water Softeners, Deionizers, Dealkalizers, Clarifiers, Aerators, Deaerating Heaters, Filters, and related products.

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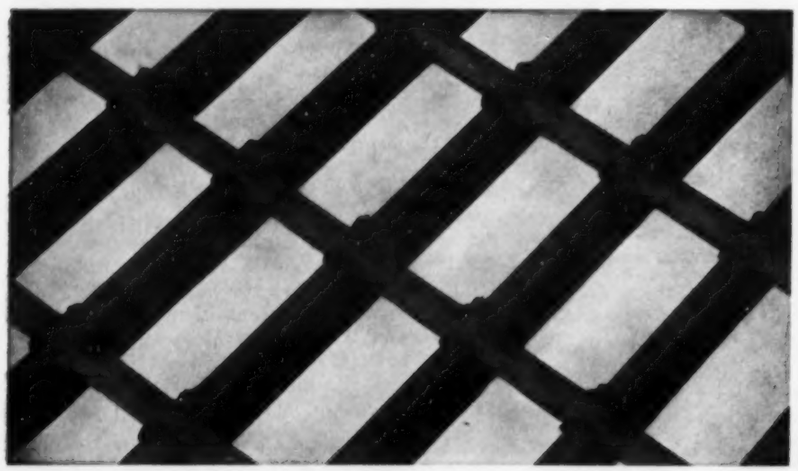

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Gary WELDED GRATING safer, stronger neat appearing

One piece construction with tops of all bars flush provides safer, longer-lasting open steel flooring. And it's tailor-made to fit your requirements. For typical installations and full details on Gary gratings, stair treads and decking, write for Catalog IP-67

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Standard Steel Spring Division
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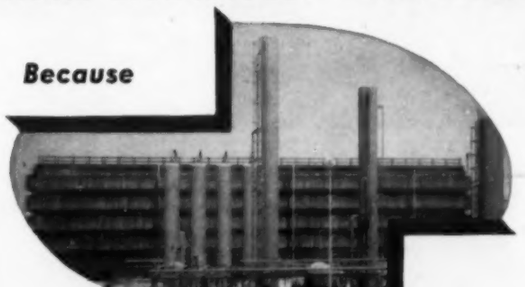
Circle 154 on READ-N-CIRCLE card for more data

To get more information on products—use the Read-N-Circle card • on page 45-46

Your Plant Water Systems MORE EFFECTIVELY PROTECTED



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A difference, which can be used to your advantage is present in the Chemical composition and behavior of Haering's Organic Chrom Glucosates*.

A Chrom Glucosate* inhibitor film is tough, tenacious, elastic yet adherent, self-sealing and impervious. Is particularly effective in waters with high sulfate and chloride contents** or where process streams introduce various complex reducing contaminants. The organic Glucosates are used at low dosage rates over wide ph Range.
Without cost or obligation find out how "Organic Methods" can provide extraordinary protection to water-using equipment in your plant.

** In use 8 years in a Cooling System where chloride content exceeds 25,000 ppm at times.

* Reg. U. S. Pat. Office.

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Distribution

. . . starts on page 18

mounting rails on the plug-in busway give a continuous ground circuit convenient to the machine. When a plug is inserted into the busway, it becomes grounded through a clamp on the mounting bar. A 4-wire drop cable, connected to the plug, has a green lead soldered to the plug and also to the machine frame. This automatically grounds equipment when the plug is inserted into the busway.

Resistance welding plays a large part in manufacturing at Roanoke. Power supply to resistance welders presents a special problem, because during the weld period, resistance welders call for a high-kva demand. A low-impedance supply circuit serves resistance welders. In this way, voltage drop is limited to less than 10% during the weld period, when welder demand is from two to four times its kva nameplate rating. Probability of overlapping weld periods of other welders is also taken into account. Impedance of the total power system behind the welder was considered and the system is designed so that impedance is small enough to give less than 10% voltage drop during the maximum kva demand in the weld period.

Three single-phase load center substations supply power to resistance welders. Low-impedance single-phase 1500-kva transformers are used to give minimum voltage drop. Substation air circuit breakers are 2 pole, and each circuit breaker feeds one or two resistance welders. Welders are connected to air circuit breakers by low-resistance interlocked armor concentric cable.

how transformer was sized

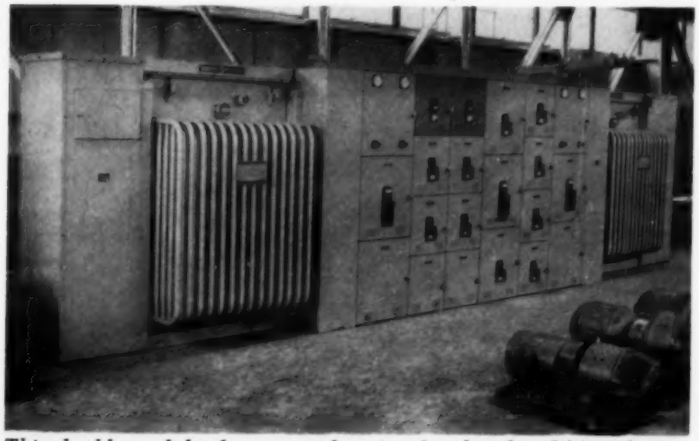
The kva size of the transformer that feeds resistance welders was determined by the transformer reactance. RMS load of resistance welders is small compared to their kva demand. For this reason, other loads can be applied on the load-center substations that feed resistance welders. Loads that can stand voltage dips without trouble are ideal for application on the same power system with resistance welders. One such load is resistance furnaces, which have a high load factor.

Plating room is supplied with power at 480 volts, 3-phase ac. Plug-in busway runs the length of the room. From this busway, dry-plate rectifiers supply dc power for plating.

In the production test area, a mezzanine was built for the motor-generator sets that provide different voltages and frequencies for test procedures. A cabinetrol control board distributes the different power requirements to test stands in the test area. Power for test area comes from a load-center unit substation on the mezzanine.

In the short circuit testing laboratory power is available to test contactors and equipment under short circuit and load

(continues on page 48)



This double-end load center substation has breaker lifting device.

"We selected Reznor heaters to do the whole job at our new East St. Louis plant because..."

"All the experience we've had with Reznor in our other plants has been 100% good. And when we added up the pros and cons of the heating system for this new plant, they came out heavily in favor of Reznor again. Here's some of the reasons why. Lower original equipment costs. Much lower installation costs. No valuable floor space required for any heating equipment, no space required for fuel storage. Low fuel costs. No maintenance problems. Dollars and cents clinched the job for Reznor but there are other advantages, too.

"Worker comfort is important to us, and everywhere we've tried it, Reznor heat has been the most comfortable heat we've ever had. Reznor contributes to worker comfort even during hot weather, because those big, powerful fans can be turned on to provide cooling air circulation."

It's the same story wherever you go. Gas unit heating is fast being recognized as the modern heating system for modern plants. And Reznor is recognized as the leading gas unit heater. There are several good reasons why Reznor sells nearly one out of every two gas unit heaters . . . efficient and economical operation – rugged construction — reliable service – long life.

For more information on Reznor gas unit heaters, mail the coupon below or call your nearby Reznor distributor. He's listed under "Heaters-Unit" in the yellow pages of your telephone directory.

REZNOR
THE WORLD'S LARGEST-SELLING GAS UNIT HEATERS

REZNOR MANUFACTURING COMPANY
70 Union Street, Mercer, Pa.

☐ Please send me my free catalog on Reznor gas heating equipment.
☐ Please have a representative call to discuss our plant heating problems.

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Company.....
Street.....
City..... State.....

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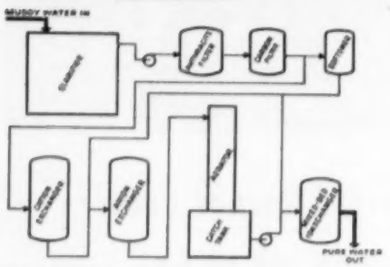
ILLCO-WAY
ionXchange

HIGH-PRESSURE BOILERS NEED PUREST WATER



An ILLCO-WAY System, incorporating up-to-date ionXchange equipment, offers the best opportunity available today for obtaining the high-purity water that modern high-pressure boilers *must* have to avoid serious loss of operating efficiency. Such a System will take the muddiest kind of hard river water and clean it up so that suspended impurities, mineral content, and dissolved solids are reduced to almost unmeasurable quantities. The result — top boiler performance, always, and top *turbine* performance.

ONE SOURCE FOR THE WHOLE SYSTEM

Today, such a System can be obtained, *complete*, from a single source — Illinois Water Treatment Company. We design and manufacture every element to solve successfully the particular application. You do not need to combine a part from here and a portion from there — you get it *all* from us, all tanks, all piping, all valves and controls, all resins and other materials, all carefully selected to suit *your* needs. *Consult our experienced engineers at the next opportunity . . .*

ionXchange
ILLINOIS WATER TREATMENT CO.
ILLCO-WAY
840 CEDAR ST.
ROCKFORD,
ILLINOIS
NEW YORK OFFICE: 141 E. 44TH ST., NEW YORK 17, N. Y.
CANADIAN DIST. PUMPS & SOFTENERS, LTD. LONDON, ONT.

Circle 104 on READ-N-CIRCLE card

test voltages. These two power supplies are fed from a separate main step-down transformer in the main substation.

dc supply is necessary

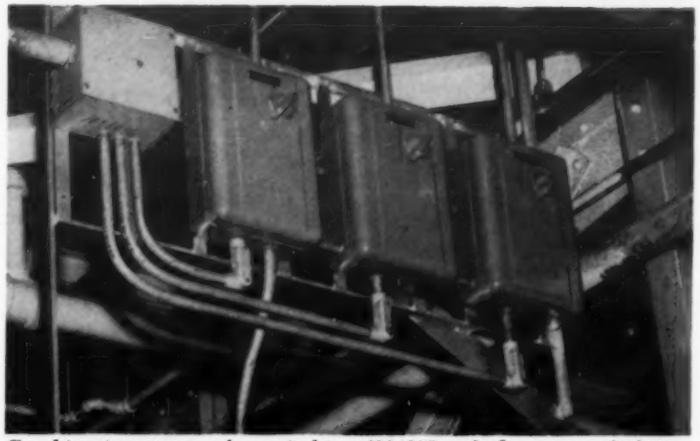
Special consideration was given to the dc short circuit test. A dc power supply was required for life testing contactors and mechanism, as well as overload interrupting and short circuit testing. A mercury-arc rectifier power supply is used. It is possible to connect the rectifiers to any one of three test setups. Arc suppression on the rectifier, backed up by the main ac metal-clad circuit breaker, is used in the test procedure. This eliminates the need for dc circuit breakers in the test setup. Basically, the power distribution system was designed to give economical continuous service to all loads.

welding load has separate circuit

Because of the heavy resistance-welding load in the plant, and the short circuit load in the testing laboratory, these two loads are separated from the general plant power supply so that voltage dips will not cause light flicker or interference with other operations. Power is metered at the 34.5-kv level.

High - voltage fluorescent lighting (instant-start fluorescent lamps with 277-volt ballast) made it easy to apply both lighting and power loads to the same load-center substations. No individual motor (250 hp) or resistance welder (50 kva or larger) large enough to give voltage drops of more than 1% was connected to the general plant power system. With this system, it is not necessary to provide separate lighting substations or individual step-down power transformers for feeding lighting. Lighting intensity in the general plant area is 35 foot-candles and gives a demand of approximately 3-volt amps/sq ft.

In general, 750-kva or 1000-kva transformers are used. Loads connected on the 4.16-kv system are limited to between approximately 2000 and 3000 kva per feeder. This gives the most economical cable size, about 500 to 750-mcm cable. Low-voltage feeders (480 volts) are limited to approximately 400 amps. This, again, is used because the most economical cable for 600-volt service is 500-mcm interlocked armored. Plug-in busway is also 400 amps.



Combination starters for switching 480/277-volt fluorescent lighting.

Consideration was given to the short circuit duty that all equipment connected to the power system must withstand. Short circuit duty on the secondary of the 1000-kva transformer is limited to less than 35,000 amps. This is the rating of the plug-in busway and other equipment connected to the 480-volt system.

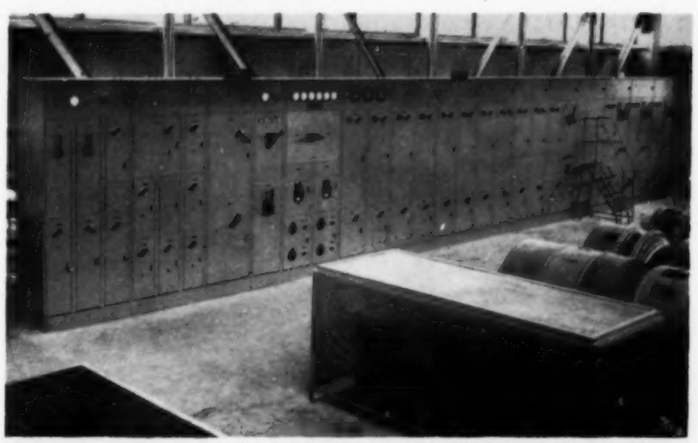
lighting panelboards have high capacity

Panelboards for 277-volt lighting are coordinated with fuses so that in combination with molded-case breakers, they can be given a rating of 25,000 amps (amount available at the panelboard) interrupting capacity. Factory lighting is switched by size-1 combination motor starters that have overload elements removed. Current-limiting fuses in these motor starters provide overload and short circuit protection.

Another requirement was for a uniform power system so that production lines and processes can be changed when new technology is discovered. This led to using plug-in busway runs on each column line. Future capacity can be added easily to the system by supplying additional load-center substations on the mezzanines when and where needed.

By using standard, off-the-shelf components of their own manufacture, General Electric Company's Roanoke plant met the exacting power requirements of all facilities from office space to experimental test work. ♦ ♦

* *See "Nine guideposts to judge purchased power reliability,"* INDUSTRY POWER, *March, 1957.*



Cabinetrol equipment distributes power needs for production tests.

handy guide

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BALTIMORE & OHIO RAILROAD. Let B&O show how bituminous fits into your long-range power plans.

(more on page 50)

HARTZELL All-Aluminum
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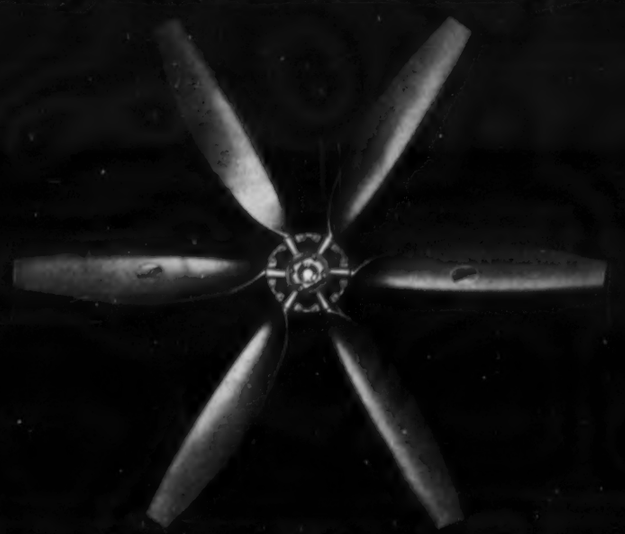

stand up under the toughest operating conditions

- Hub and blades are precision-finished aluminum-alloy castings. Cast aluminum construction combines high strength with exceptional resistance to corrosion.
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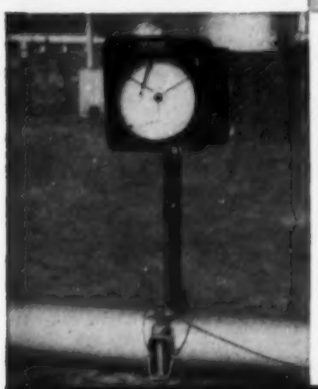
Circle 103 on READ-N-CIRCLE card for more data

AUTO-LITE

...for TEMPERATURE RECORDING...

One of the many uses for Auto-Lite Recorders is the application shown below . . . a natural gas field meter run.



Auto-Lite Model "1000" Temperature Recorder has 6" chart. Various standard ranges from minus 40° F to plus 550° F. Available for wall mounting, portable or portable self contained use. Electric or mechanical chart drive. Choice of 24-hr. or 7-day cycle. Capillary tubing permits remote reading. Priced as low as $49.50. Manufactured to customers' specifications. Send for latest Catalog describing many types of Auto-Lite Recorders and Indicators.

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS & INDICATORS

Circle 136 on READ-N-CIRCLE card for more data

handy guide

. . . starts on page 49

Coals for industry
Read page 46—circle number 113
PICKANDS MATHER & Co. Since 1883 PM has offered choice coals. Call representative.

HEAT EXCHANGERS

All-aluminum fans are tough
Read page 49—circle number 103
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Cool with atmospheric air
Read page 52—circle number 107
NIAGARA BLOWER Co. Areo heat exchangers cool jacket water for engines and process equipment.

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Make or break electric circuit
Read page 43—circle number150
THE MERCOID CORP. Write for details of differential pressure controls.

Meters do more than measure
Read page 43—circle number 156
BUFFALO METER Co. Liquid meters standardize quality, aid cost control. Write for details.

Safe water level indicator
Read page 36—circle number 112
THE RELIANCE GAUGE COLUMN Co. Eye-Hye gives accurate boiler water level readings.

Detect O_2 in feedwater
Read page 39—circle number 102
CAMBRIDGE INSTRUMENT Co., INC. Spotting oxygen in feedwater; helps prevent corrosion.

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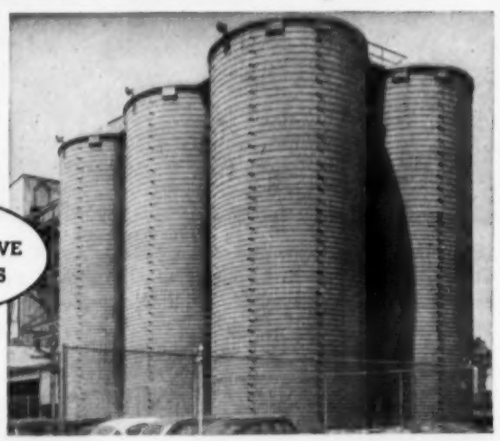
YARNALL-WARING Co. Yarway remote liquid level indicators are safe, accurate.

There's a heavy conveying system atop these Neff and Fry Bins

SUPER-CONCRETE STAVE STORAGE BINS



A continuous reinforced concrete roof on the six 20' x 52½' bins carries a big screw conveyor with piers, chutes, etc. Observe that there are no additional supports from the ground. The bins themselves support the entire load.

This strikingly proves the load-bearing strength of Neff & Fry Bins. Of course, the bins also have the lateral strength to contain 4,000 tons of grain.

The walls of Neff & Fry Bins are constructed of Super-Concrete Staves. For a complete understanding, read our folder, "Bins With the Strength of Pillars." Ask for it now before you forget.

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To get more information on products—use the Read-N-Circle card • on page 45-46

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STRATEGICALLY LOCATED WAREHOUSE STOCKS

Monarch ELECTRIC CORPORATION
Jamestown, New York

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Low-cost temperature recorders
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THE ELECTRIC AUTO-LITE CO., INSTRUMENT AND GAGE DIV. Auto-Lite temperature recorders come in all ranges, types.

Pilot resets automatically
Read page 41—circle number 153
UNITED STATES GAUGE. New temperature pilot has automatic reset. Investigate complete gage line.

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Seamless metal hose
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COBRA METAL HOSE. Use custom-constructed hose assemblies for your power system.

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Handling heavy fuel oils?
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TUTHILL PUMP CO. SU pump unit handles heavy fuel oils. Large choice of pumps, motors.

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Oil-strangled air traps?
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Save fuel, water, labor
Read page 38—circle number 142
UNIBLOW VALVE CO. Continuous blowoff valve keeps boiler cleaner, insures accurate control.

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Read about it on page 13.

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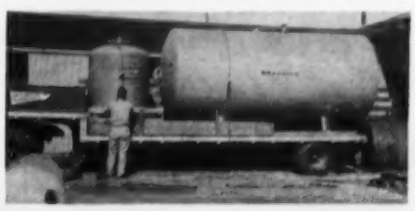

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300	G.E.	440	250
250	G.E.	440	250
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200	Westg.	2300/4000	250/275
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500	G.E.	KT-424	450
350	*G.E.	KT-559A	1800
250	West CS-81205	TEFC	1800
250	B.E. (2)	KT-559	1800
250	*L-Allis	OEX-148	720
250	*G.E.	IK	600
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HP	Make	Type	Speed
2500	*G.E.	MT	257
1200	*Al-Ch	ANT	1800
600	*G.E.	MT	450
500	G.E.	M-6345	1200
300	G.E.	IM-178	600
250	*G.E.	IM	720
200	G.E.	IM	600
200	Westg. (2)	CW	514
200	*Westg.	CW-905-A	514
150	Cr-Wh.	50-R	1800

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250	Al.-Ch.	SYN	1.0	1200
225	G.E.	TS-6244	1.0	300
225	Elec. Mchy.		1.0	360
190	Elec. Mchy.		1.0	720

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See Thermix Corp.

AEROVENT FAN CO. INC. . . . Page 30
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CHICAGO 6, ILL.: Barrett-Christie Co., 118 N. Clinton St., FRanklin 2-9540.
DES MOINES 9, IOWA: Fred E. Triggs, 200 Plymouth, 3-6976.
DETROIT 3, MICH.: Merlo Steam Equipment Co., 1506 E. State Fair, TW 1-7005.
DULUTH 2, MINN.: Williams-Swanson Co., 208 Builders Exch. Bldg., RA 7-1767.
EVANSVILLE 8, IND.: Evansville Supply Co., 810 Penn St., 5-7261.
GRAND RAPIDS 2, MICH.: Hayden Supply Co., 41 Market Ave., S. W., GLendale 1-2711.
INDIANAPOLIS 9, IND.: Indianapolis Belt & Sup. Co., 34 So. Capitol Ave., MElrose 5-8604.
KANSAS CITY 11, MO.: Hughes Machinery Co., 4212 Main St., VA 3-2091.
KNOXVILLE 5, TENN.: Leinart Engrg. Co., 412 E. Fifth Ave., 5-0363.
LOUISVILLE 2, KY.: Graft Pelle Co., 309 W. Main St., AMherst 2466.
MEMPHIS 4, TENN.: Power Equipment Co., 1352 Madison Ave., BR 2-2867.
MILWAUKEE 4, WIS.: The Williams Engineering Co., 331 W. National Ave., EVergreen 4-4220.
MILWAUKEE 3, WIS.: K. F. Hamacher Engineering Co., 2540 W. Wells St., WEst 3-9322.
MINNEAPOLIS 6, MINN.: Blesi-Evans Co., 2803 Riverside Ave., FEderal 9-7019.
ST. LOUIS 3, MO.: O'Brien Equipment Co., 2832 Olive St., JEfferson 3-2091.
SOUTH BEND 23, IND.: Smith Monroe Co., 1912 S. Main St., ATlantic 6-6343.
WOOSTER, OHIO: Steam Economies Co., Quinby Bldg., HOward 2-8831.

BABCOCK & WILCOX CO., BOILER DIV. . . . . Page 3
NEW YORK 17, N .Y.: (Home Office) 161 E. 42nd St.

BALTIMORE & OHIO RAILROAD . . . . . Page 4
CHICAGO 7, ILL.: S. G. Alexander, Grand Central Station, Harrison & Wells Sts.
CINCINNATI 2, OHIO: M. S. Hall, Temple Bar Bldg., Court & Main Sts.
CLEVELAND 13, OHIO: C. H. Norris, Jr., 901-03 Terminal Tower Bldg.
DETROIT 26, MICH.: C. E. Schroeder, 154 W. Lafayette Blvd.

ARNOLD O. BECKMAN, INC. . . . . Page 10
SOUTH PASADENA, CALIF.: (Home Office) 1025 Mission St.

BELL & ZOLLER COAL CO. . . Page 31
CHICAGO, ILL.: (Home Office) 307 N. Michigan Ave.

BETZ LABORATORIES, INC. . . Page 11
PHILADELPHIA 24, PA.: (Home Office) Gillingham & Worth Sts.

THE BIRD-ARCHER CO. . . . . Page 38
COOPERSVILLE, MICH.: W. E. Elliott, R#1.
FINDLAY, OHIO: R. F. Donnelly, 1921 Geffs Ave.
PHILADELPHIA 40, PA.: (Home Office) 4337 American St.

BOILER TUBE CO. OF AMERICA . . . . . Page 28
CHICAGO, ILL.: STate 2-7955.
CLEVELAND, OHIO: YEllowstone 2-6105.

BUELL ENGINEERING CO. . . Page 39
NEW YORK, N. Y.: (Home Office) 70 Pine St.

BUFFALO METER CO. . . . . Page 43
CHICAGO 10, ILL.: Meters & Controls, Inc., 444 N. LaSalle St., WH 4-1448.
CINCINNATI 37, OHIO: Chapman Engineering Sales Co., 1717 Section Rd., ELmhurst 3140.
CLEVELAND 13, OHIO: Illes Power Control Co., 22700 Shore Center Dr., REdwood 2-9300.
DES MOINES 9, IOWA: Deco Engrg. Products, 1112 Locust St., 8-5721.
DETROIT 12, MICH.: Metrol Co., 7145 E. Davison. TWinbrook 3-6300.
INDIANAPOLIS 4, IND.: DeHaven Engineering Co., 1444 Consolidated Bldg., 115 North Penn. St., MElrose 2-2563.
KANSAS CITY 14, MO.: Economy Equipment Co. 7341 B'way. JAckson 3-1010.
KNOXVILLE 5, TENN.: Leinart Engineering Co., 412 E. Fifth Ave., 5-0363.
MEMPHIS 5, TENN.: C. J. Gaskell Co., Inc., 216 N. Lauderdale Ave., 8-2241.
MILWAUKEE 4, WIS.: Geo. H. Fredricks & Co., Inc., 4385 N. Green Bay Ave., COncord 4-1070.
MINNEAPOLIS 2, MINN.: Berry Ervin Engineering Co., Builders Exchange Bldg., FEderal 2-8861.
ST. LOUIS 8, MO.: Economy Equipment Co., 4526 Olive St., FOrest 7-5328.

BULLDOG ELECTRIC PRODUCTS CO. . . . . Page 29
CHICAGO 6, ILL.: A. G. Curtin, 600 W. Jackson Blvd., Rm. 513, CEntral 6-3945; G. A. Fassnacht, 600 W. Jackson Blvd., Rm. 413, RAndolph 6-1895.
CINCINNATI 13, OHIO: J. A. McGonegle, 6408 Orchard Lane, JEfferson 1-4299; G. P. Bowman, Boerger Bldg., Rm. 4, 2209 Losantiville Ave., REdwood 1-7460.
CLAYTON 5, MO.: E. N. Cahoon, 7603 Forsyth Blvd., Rm. 200, PA 7-6090.
CLEVELAND 15, OHIO: P. E. Morgan, Rm. 524, B. F. Keith Bldg., PR 1-6584.
COLUMBUS 15, OHIO: M. V. Kessler, H. C. Dale, 22 South Young St., Rm. 301, 302, CApitol 8-6734.
CUYAHOGA FALLS, OHIO: D. W. Frazier, Jr., 2316-11th St., SWandale 4-8359.
DAYTON 9, OHIO: C. L. Cramer, 53 Park Ave., OXmoor 5801.
DETROIT 2, MICH.: J. D. Akers, 525 Harper Ave., TRinty 5-4350.
GRAND RAPIDS, MICH.: W. N. Keddie, 710 Griswold, S. E., GLendale 2-4858.
INDIANAPOLIS 2, Ind.: A. L. Crawford, 1495 N. Harding St., MElrose 2-6431.
KANSAS CITY 9, MO.: J. W, Rae, P. O. Box 4757, VIctor 2-3831.
LOUISVILLE 7, KY.: R. W. Spargur, Rm. 226-3620 Lexington Rd., TW 6-4217.
PLAINWELL, MICH.: H. B. Moerdyk, 633 Riverview, R. R. #1, MUrray 2-6374.
MILWAUKEE 1, WIS.: C. L. Seaholm, P. O. Box 1664, COncord 4-7100.
MINNEAPOLIS 26, MINN.: Alton M. Johnson Co., 3119 Lynn Ave., WAlnut 7-8741.
TOLEDO 14, OHIO: C. E. Meister, 3284 Winston Ave., WAlbridge 0529.

BYRON JACKSON PUMPS, INC. . . . . Page 56
See local office listing on Page 56.
LOS ANGELES 54, CALIF.: (Home Office) Box 2017, Terminal Annex.

CAMBRIDGE INSTRUMENT CO., INC. . . . . Page 39
NEW YORK 17, N. Y.: (Home Office) 3778 Grand Central Terminal Bldg.

COBRA METAL HOSE, DIV. OF DK MFG. CO. . . . . Page 37
CHICAGO, ILL.: Power Transmission Equipment Co., 1245 West Fulton St.
CLEVELAND, OHIO: Koehler Rubber & Supply Co., 3865 Carnegie Ave.

COPPUS ENGINEERING CORP. . . . . Page 40
WORCESTER, MASS.: (Home Office) 262 Park Ave.

DEARBORN CHEMICAL CO. . . Page 33
CHICAGO 43, ILL.: A. W. Johnson, 1840 W. 105th St.
CHICAGO 54, ILL.: E. W. Houseknecht, A. R. Tanis, Dearborn Chemical Co., Merchandise Mart Plaza.
CINCINNATI 8, OHIO: D. D. Powers, 1128 Paxton Ave.
CLEVELAND 28, OHIO: J. W. Fisher, 17020 Glendale Ave.
DETROIT 35, MICH.: J. H. Alm, T. W. Mack, 18954 James Couzens Hwy.
EARLVILLE, ILL.: J. P. Byrnes, R. R. #3.
EAST LANSING, MICH.: T. J. Weisbruch, 648 Gunson St.
EASTLAKE, OHIO: J. R. Fletcher, 281 Willowick Dr.
FLORISSANT, MO.: C. D. Schroeder, 435 Larry Dr.
GREEN BAY, WIS.: R. H. Fritschel, 920 Meacham.
HILLSIDE, Ill.: T. Zaggy, 4511 Jackson Blvd.
INDIANAPOLIS 3, IND.: G. B. Thurston, 4101 E. Naomi St.
JASPER, IND.: H. Beyersdorf, Jr., 115 East Fourth St.
KANSAS CITY, MO.: E. W. Roberts, 5827 Wabash.
MARIETTA 7, OHIO: J. A. Crenner, 519 Adams St.
MARION, OHIO: R. J. Maginn, 140 Clover Ave.
MINNEAPOLIS 24, MINN.: R. T. Moran, 5409 Mirror Lakes Dr.
NASHVILLE 4, TENN.: G. E. MacLean, 3503 Rainbow Place.
ROCK ISLAND, Ill.: R. O. Benson, 4000-22nd Ave.

DETROIT STOKER CO. . . . . Page 32
CHICAGO, ILL.: Detroit Stoker Co., 222 W. Adams St.
CINCINNATI, OHIO: Detroit Stoker Co., 2904 Woodburn Ave.
CLEVELAND, OHIO: Detroit Stoker Co., 1621 Euclid Ave.
DES MOINES, IOWA: W. H. Bixby, Inc., Walnut Bldg.
DETROIT, MICH.: Detroit Stoker Co., General Motors Bldg.
KANSAS CITY, MO.: Harry McPherson, 4049 Pennsylvania Ave.
MEMPHIS, Tenn.: Allen-Shuff Corp., 166 Monroe Ave.
MINNEAPOLIS, MINN.: Detroit Stoker Co., Foshay Tower.
NASHVILLE, TENN.: Allen-Shuff Corp., 1121 Church St.

ELECTRIC AUTO-LITE CO. . . Page 50
CHICAGO, ILL.: R. R. Hopkins, 600 S. Michigan Ave., WEbster 9-3144.
TOLEDO 1, OHIO: 1201 Champlain St., CHerry 3-3131.

ELGIN SOFTENER CORP. . . . . Page 44
CHICAGO 11, Ill.: F. M. Nourse Associates, 664 N. Michigan Ave., SU 7-9592.
CINCINNATI 12, OHIO: Wilcox Engineering Co., 4200 Montgomery Rd., P. O. Box 16, ELmhurst 1-4935.
CLEVELAND, OHIO: Plant Equipment Co., 16711 Lakewood Hghts., LA 1-5157.
COLUMBUS 15, OHIO: Carl J. Baum, 880 East Broad St., CLearbrook 8-9515.
DES MOINES 12, IOWA: Elwood C. Giberson, 4110 Greenwood Dr., 9-1736.
DETROIT, MICH.: William A. Dalee, 9190 Roselawn Ave., WEbster 3-4430.
HOPKINS, MINN.: Lloyd G. Cherne, 11203 North Oakvale Rd., WEst 8-3814.
INDIANAPOLIS 2, IND.: H. T. Nancrede, 1842 Central Ave., WAlnut 3-7616.
KANSAS CITY, MO.: F. S. Crook, 1733 Walnut St., VIctor 2-6200.
MILWAUKEE, WIS.: Steam Plant Equipment Co., 3074 N. 79th St., HI 2-3510.
OMAHA, NEB.: E. P. Dempsey Co., 2431 Camden Ave., PLeasant 9380.
ST. LOUIS 1, MO.: F. S. Crook, 1004 Market St., CHestnut 1-3511.

FLEXROCK CO. . . . . Page 44
PHILADELPHIA 1, PA.: (Home Office) 3609 Filbert St.

GLOBE CO. . . . . Page 24
CHICAGO, ILL.: Steel Sash Service, Inc., 2141 Lawrence Ave., UP 8-7500.
CINCINNATI, OHIO: Oral T. Carter & Associates, 1704 Dreman, MU 1-1680.
CLEVELAND, OHIO: Morrison Company, 4119 Prospect Ave., EX 1-6767.
COLUMBUS, OHIO: Loeb Electric Company, 915 Williams Ave., AX 9-1142.
DES MOINES, IOWA: Electrical Engineering & Equip. Co., 1201 Walnut St., 20431.
DETROIT, MICH.: Koehler & Pasmore Company, 11833 Hamilton, TO 8-3322.
KANSAS CITY, MO.: Unistrut Distributing Corp., 5018 Main St., WE 1-9694.
KNOXVILLE, Tenn.: Southeastern, Inc., 917 Cooper St., 4-4235.
LITTLE ROCK ARK.: Power-Strut Southern Service Co., Box 2698, 4-8314.
LOUISVILLE, KY.: Todd Donigan Company, 811 West Main St., JAckson 3161.
MEMPHIS, TENN.: Power-Strut Southern Service Co., 2523 Broad St., 33-8981.
MINNEAPOLIS, MINN.: Skarnes Engineering & Supply Co., 2907 E. Franklin, FEderal 9-2719.
MILWAUKEE, WIS.: E. G. Artz, Inc., 1929 West Clybourn, WEst 3-3202.
NASHVILLE, TENN.: Southeastern, Inc., 207 Twelfth Avenue, South, AL 5-0613.
PEORIA, ILL.: R. E. Common Equipment Co., 1515 S. Washington, 6-8778.
ROCK ISLAND, ILL.: Plant Equipment Co., 2509 Fifth Ave., RO 6-3369.
ST. LOUIS, MO.: Thomas, Inc., 114 S. Bemiston, PArkview 1-5288.
SOUTH BEND, IND.: Fabricated Steel Products, 2025 S. Main St., AT 8-4411.
TOLEDO, OHIO: Fred Willyard Company, 722 Ontario, CHerry 8-2282.

GRAPHIC SYSTEMS INC. . . . Page 28
NEW YORK, N. Y.: (Home Office) 55 W. 42nd St.

GUYAN EAGLE COAL CO. . . Page 12
DETROIT 26, MICH.: 3108 Book Tower Bldg., WOodward 1-6356.

D. W. HAERING & CO. INC. . . Page 44
SAN ANTONIO, TEX.: (Home Office) P. O. Box 6037.

HARTZELL PROPELLER FAN CO. . . . . Page 49
CHATTANOOGA, TENN.: 2001 Broad St., 5-3407.
CHICAGO 40, ILL.: 1249 Devon Ave., BRiargate 4-2620.
CINCINNATI 7, OHIO: 1836 Dana Ave., MElrose 12945.
CLEVELAND 13, OHIO: 2012 W. 25th St., SUperior 1-5022.
DAYTON 9, OHIO: 120 Stonemill Rd., MIchigan 8032.
DETROIT 2, MICH.: 807 New Center Bldg., TRinity 5-2045.
INDIANAPOLIS 8, IND.: Box 5002, Station A, MElrose 6-1478.
LOUSVILLE 1, KY.: P. O. Box 64, GLendale 8-2709.
MILWAUKEE 4, WIS.: 1225 W. Mitchell St., MItchell 5-1370.
MINNEAPOLIS 3, MINN.: 620 Plymouth Bldg., FEderal 2-0528.
NORTH LITTLE ROCK, ARK.: 109 S. Main St.
ROCK ISLAND, ILL.: 3209-35th Ave., 6-7519.
ST. LOUIS 19, MO.: P. O. Box 4, Webster Groves Sta. WOodland 1-7816.
TOLEDO 10, OHIO: 2909 Detroit Ave., CHerry 4-5431.

HUNGERFORD & TERRY, INC. . . . . Page 43
CHICAGO 4, ILL.: Ross Engineering, 224 S. Michigan Ave., WEbster 9-4721.
CLEVELAND 3, OHIO: R. D. Murphy, 6801 Euclid Ave., HEnderson 2-1900.
DETROIT 27, MICH.: Clifford B. Armstrong, Jr., 16817 Gr. River Ave., VE 8-4249.
INDIANAPOLIS 20, IND.: H. C. Ohge, 5324 Primrose Ave., BRoadway 7316.
KANSAS CITY 9, MO.: Parker & Foster, 3519 Troost Ave., JEfferson 4490.
LOUISVILLE 2, KY.: Allan K. Cook Co., 604 W. Main St., WAbash 1269.
MEMPHIS 5, TENN.: C. J. Gaskell Co., 216 N. Lauderdale Ave., ME 8-2241.
ST. LOUIS 10, MO.: Hudson Chem. Co. 4010 Chouteau Ave., JEfferson 1-7843.

(more locator on page 54)

the LOCATOR

. . . starts on page 53

ILLINOIS WATER TREATMENT CO. .....Page 48
ANN ARBOR, MICH.: Lloyd J. Wicks, P. O. Box 2161, TU 2-4170 (Detroit).
CHICAGO 45, ILL.: Bob Goynshor, 7546 No. Oakley Ave., AMbassador 2-5317.

INFILCO, INC. .....Page 2
BATTLE CREEK, MICH.: R. W. Schneider, 131 Lakeview Ave., WOodward 4-2306.
CHICAGO, ILL.: Battey-Sterlin, 325 W. 25th Pl., CAlumet 5-2525.
DETROIT, MICH.: McBride-Pearson, TRInity 2-8000.
KANSAS CITY, MO.: H. J. Karsten, Rm. 207, 6315 Brookside Plaza, DE 3-6489.
MINNEAPOLIS, MINN.: D. E. Colvin, 244 Plymouth Bldg., FEderal 2-4439, and Reed & King, Inc., 4029 Vernon Ave. South, WAlnut 7-9731.
PEORIA, ILL.: E. A. Engelmann, 700 First Nat'l Bank Bldg., PEoria 6-2516.
ST. LOUIS, MO.: E. W. Butler & Assoc., 8515 Delmar Blvd.

THE INTERNATIONAL BOILER WORKS CO. .....Page 35
CLAYTON 5, MO.: Mechanical Works Engineering Co., 153 N. Meramec Ave., VOlunteer 3-6050.
CLEVELAND 12, OHIO: M. G. Limbach Co., 13231 Euclid Ave., POtomac 1-3530.
DAYTON 2, OHIO: Gary G. Schultz & Associates, 410 West 1st St., MI 0772.
DETROIT 7, MICH.: Bartels Heating Service 1222 Bellevue Ave., LO 7-7217.
FERN CREEK, KY.: J. Zimmermann, P. O. Box 66, FErn Creek 3315.
INDIANAPOLIS 5, IND.: N. R. Colbert, 609 E. 23rd St., WAlnut 3-5683.
KANSAS CITY, MO.: The Glennon Co., P. O. Box 2275, 210 W. 8th St., VI 2-0587.
MEMPHIS 5, TENN.: C. J. Gaskell Co., Inc., 216 Lauderdale Ave., JA 6-2241.
MINNEAPOLIS 6, MINN.: Philip R. Reese, Inc., 3747 Minnehaha Ave., PArkway 1-1673.
NASHVILLE 4, TENN.: Ryan Sales Co., P. O. Box 276, Phone 5-8584.
WATERTOWN, WIS.: Ernest A. Biefeld Engineering Co., Box 177, Phone 376.

I-T-E CIRCUIT BREAKER CO., SMALL AIR CIRCUIT BREAKER DIV. .....Page 8
CHICAGO 3, ILL.: Bankers Building, Room 1719, 105 West Adams St.
CINCINNATI 27, OHIO: 6953 Thorndike Road.
CLEVELAND 15, OHIO: 631 Hanna Bldg., 14th Street and Euclid Ave.
DETROIT 26, MICH.: Guardian Bldg., Room 1512, 500 Griswold St.
INDIANAPOLIS 4, IND.: Geo. A. Wright, 609 Roosevelt Bldg.
KANSAS CITY, 5, MO.: Room 920, Dwight Bldg.
MILWAUKEE, WIS.: Room 405, 210 Michigan Ave.
MINNEAPOLIS 3, MINN.: 326 Plymouth Bldg., Hennepin and Sixth St.
ST. LOUIS 5, MO.: 7 North Brentwood Blvd.

JOHNSON SERVICE CO. .....Pages 6, 7
AKRON 2, OHIO: 363 W. Exchange St.
APPLETON, WIS.: 516 E. Wisconsin Ave.
AURORA, ILL.: 601 S. Broadway.
CEDAR RAPIDS, IOWA: 403 Dows Bldg.
URBANA, ILL.: 1401 E. Main St., P. O. Box 110.
CHICAGO 7, ILL.: 1355 Washington Blvd.
CINCINNATI 14, OHIO: 1905 Dunlap St.
CLEVELAND 15, OHIO: 2142 E. 19th St.
COLUMBUS 1, OHIO: 1130 N. High St.
DAYTON 9, OHIO: 2340 E. River Rd.
DES MOINES 9, IOWA: 1217 Grand Ave.
DETROIT 20, MICH.: 840 Hilton Rd.
DULUTH 6, MINN.: 2311 W. Superior St.
EVANSTON, ILL.: 2231 Howard St.
GRAND RAPIDS 7, MICH.: 1346 Burton St., S.E.
HARVEY, ILL.: 15407 Center Ave.
INDIANAPOLIS 4, IND.: 333 N. Pennsylvania St.
KANSAS CITY 5, MO.: 1031 Wyandotte
KINGSPORT, TENN.: 214 Commerce St.
KNOXVILLE, TENN.: 5122 Kingston Pike.
LA CROSSE, WIS.: 319 State Bank Bldg.
LITTLE ROCK, ARK.: 110 W. 13th St.
LOUISVILLE 2, KY.: 2251 S. Shelby St.
MADISON 5, WIS.: 4253 Avon Rd.
MEMPHIS 5, TENN.: 211 No. Lauderdale St.
MILWAUKEE 1, WIS.: 207 E. Michigan
MINNEAPOLIS 12, MINN.: 3639 Washington Ave., North.
MOLINE, ILL.: 308 First Nat'l Bank Bldg.
NASHVILLE 3, TENN.: 105 16th Ave., S.
PEORIA, ILL.: 1422 N. Adams St.
SAGINAW, MICH.: 1840 N. Michigan St.
ST. LOUIS 3, MO.: 3541 Lawton Blvd.
SOUTH BEND 18, IND.: 105 W. Garst St.
TOLEDO 6, OHIO: 3239 Monroe St.
WILMETTE, ILL.: 400 Linden Ave.
YOUNGSTOWN 2, OHIO: 3743 South Ave.

L*A WATER SOFTENER CO. .....Page 51
GLENDALE 1, CALIF.: (Home Office) 1007 Air Way.

MAGNETROL, INC. .....Page 40
CHICAGO 10, ILL.: Meters and Controls, 444 North LaSalle St., WHitehall 4-1446.
CLEVELAND 23, OHIO: Iles Power Control Co., 22700 Shore Center Dr., REdwood 2-9300.
CLINTON, IOWA: Meters and Controls Room 208, Johannes Bldg., CH 3-2033.
DAVENPORT, IOWA; Deco Engineering Products, 320 Western Ave., 7-6123.
DES MOINES 9, IOWA: Deco Engineering Prod., 1112 Locust St., 8-5721.
DETROIT 7, MICH.: Smith Instrument & Equipment Co., 1900 East Jefferson Ave., LOrain 7-3550.
GRAND RAPIDS 7, MICH.: Kress Engineering & Sales Co., 1342 Burton Ave., S. E., GLendale 2-9176.
INDIANAPOLIS 5, IND.: C. M. Buck, 2927 Central Ave., WAlnut 5-1832.
KANSAS CITY, MO.: Economy Equipment Co., 7341 Broadway, JA 3-1010.
MEMPHIS 5, TENN.: C. J. Gaskell Co., Inc., 216 North Lauderdale Ave., 8-2241.
MINNEAPOLIS 9, MINN.: Engineered Sales 314 West 38th St., LOcust 0696.
MUSKEGON, MICH.: Smith Instrument & Equipment Co., 1466 Bearsley.
RIPON, WIS.: Yates Equipment & Supply Co., P. O. Box 331, BLack 600.
ST. LOUIS, MO.: Economy Equipment Co., 4526 Olive St., FOrest 5328.
TOLEDO 9, OHIO: Mason Equipment Co., 1601 Broadway, FUlton 4269.
CINCINNATI 8, OHIO: The Abbott Co., 3437 Michigan Ave., EA 1-2349.
COLUMBUS, OHIO: The Abbott Co., 1342 Highland St., AX 9-4244.
LOUISVILLE, KY.: The Abbott Co., 366 Francis St., JUniper 4-4713.

THE MERCOID CORP. .....Page 43
CINCINNATI, OHIO: The Richard Equipment Co., 2137 Reading Rd.
CLEVELAND, OHIO: R. G. Davis & Co., 15963 Euclid Ave.
DETROIT 2, MICH.: R. L. Deppmann Co., 1120 W. Baltimore.
INDIANAPOLIS 2, IND.: Electro Products, Inc., 702 E. 10th St.
MILWAUKEE 2, WIS.: Hansen Engr. Co., 315 E. Detroit St.
ST. LOUIS 10, MO.: Fillo Sales & Engr. Co., 4401 Chouteau Ave.
TOLEDO 2, OHIO: Girkens Electric Co., 2056 Canton St.

MONARCH ELECTRIC CORP. .....Page 50
JAMESTOWN, N. Y.: (Home Office) 118 E. First St.

MORTON SALT CO. .....Page 55
CHICAGO 54, ILL.: F. B. Beattie, A. C. Askelof, M. J. Hanson, Merchandise Mart Plaza.
DES MOINES 9, IOWA: J. C. Manning, 901 Fleming Bldg.
DETROIT 8, MICH.: L. R. Webster, 2444 W. Warren Ave.
KANSAS CITY 10, MO.: R. G. Achorn, W. H. Jackson, 6175 The Paseo.
MILWAUKEE 46, WIS.: C. P. McNamara, 1400 W. Bruce St.
ST. LOUIS 2, MO.: J. B. Page, 820 Gratiot St.
WADSWORTH, OHIO: F. J. Schreiber, S. Main St.
MINNEAPOLIS 1, MINN.: Carl Landgren, 505 N. Third St.

MULTI-AMP CORP. .....Page 34
UNION, N. J.: (Home Office) 467 Lehigh Ave.

NATIONAL AIROIL BURNER CO. .....Page 37
PHILADELPHIA 34, PA.: (Home Office) 1350 E. Sedgley Ave.

NEFF & FRY CO. .....Page 50
BLOOMINGTON, ILL.: Henry A. Sullivan, 609 E. Washington St., 6201-0.
CEDAR RAPIDS, IOWA: R. F. Horak, 2911 Meadowbrook S.E., 2-6187.
CHICAGO 5, ILL.: W-M Corp., 608 South Dearborn St., HArrison 7-7778.
MARQUETTE, MICH.: C. T. DeHaas Co., Box 89, Phone 320 or 321.
SAGINAW, MICH.: H. C. Roeser, Box 175, W. S. 2-6031.
ST. LOUIS 24, MO.: Missouri Construction Machinery Co., 8861 Ladue Rd., PArkview 7-5748.

NIAGARA BLOWER CO. ....Page 52
NEW YORK 17, N. Y.: (Home Office) 405 Lexington Ave.

PEABODY ENGINEERING CORP. .....Page 30
NEW YORK 16, N. Y.: (Home Office) 232 Madison Ave.

PICK MFG. CO. .....Page 28
CLEVELAND 6, OHIO: John McGuckin, 1416 E. 93rd St.
DETROIT 38, MICH.: Steam Specialties Co., 15794 Wyoming Ave.
KANSAS CITY 6, MO.: S. C. McCann Co., 210 West 10 St.
MINNEAPOLIS, MINN.: Ruffridge-Johnson Equipment Co., 3025 S. E. 4th St.
ST. LOUIS 10, MO.: Barger Equipment Co., Inc., 4030 Chouteau Ave.
WHEATON, ILL.: Omer Daily, 307 Pierce St.

PICKANDS MATHER & CO. ..Page 46
CLEVELAND, OHIO: (Home Office) Union Commerce Bldg.

PRAT-DANIEL CORP. .....Page 27
See Thermix Corp.

RELIANCE GAUGE COLUMN CO. .....Page 36
CHICAGO 4, ILL.: W. P. Nevins Company, 53 West Jackson Blvd.
CINCINNATI 37, OHIO: Chapman Engineering Sales Co., 1720 Section Road.
CLEVELAND 15, OHIO: The L. H. Waldrip Company, 3030 Euclid Ave.
DES MOINES 9, IOWA: Midwest Controls Company, 1010 Cherry St.
DETROIT 12, MICH.: Metrol Company, 7145 East Davison St.
INDIANAPOLIS 4, IND.: DeHaven Engineering Company, 1444 Consolidated Bldg., 115 N. Pennsylvania St.
KALAMAZOO, MICH.: Metrol Company, 420 West South St.
KANSAS CITY 12, MO.: Economy Equipment Company, 7341 Broadway.
MILWAUKEE 9, WIS.: George H. Fredricks & Co., 4385 N. Green Bay Ave.
MINNEAPOLIS 12, MINN.: Bell & Eiss, Inc., Foshay Tower.
ST. LOUIS 8, MO.: Economy Equipment Company, 4526 Olive St.
TOLEDO 2, OHIO: Metol Company, 2154 Madison Ave.

REZNOR MFG. CO. .....Page 47
CHICAGO 30, ILL.: 4652 W. Lawrence Ave., AVenue 3-3322.
CINCINNATI 6, OHIO: 1616 Madison Rd., CApitol 1-1400.
CLEVELAND 12, OHIO: 15963 Euclid Ave., LIberty 1-0663.
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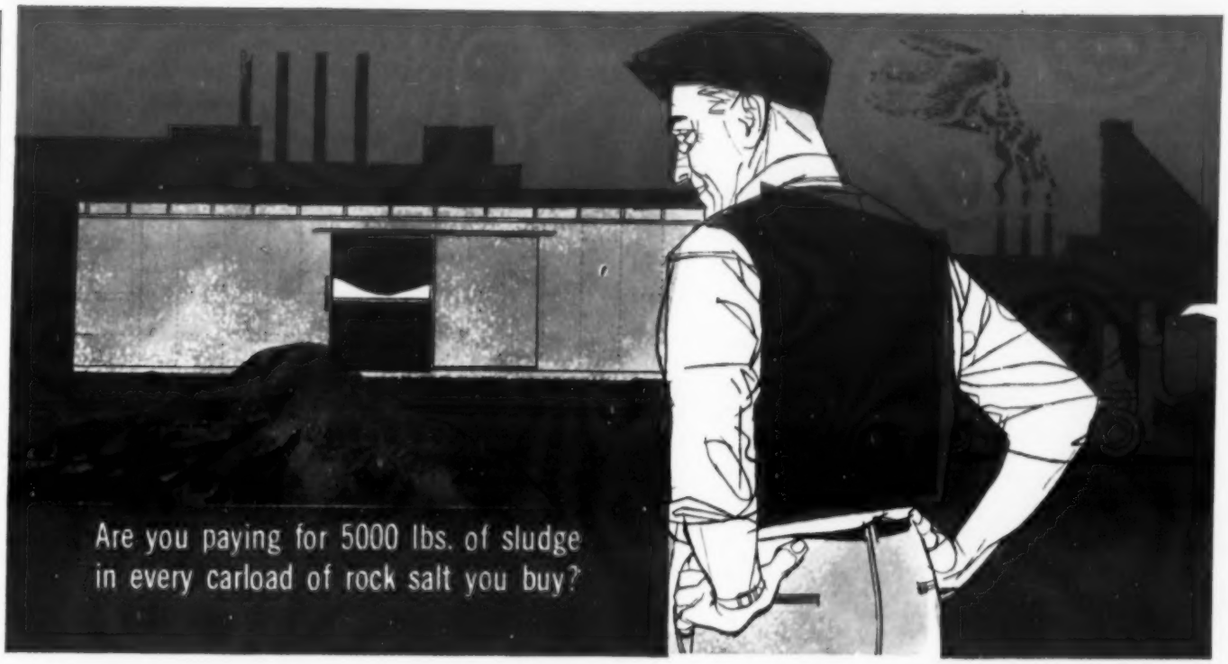

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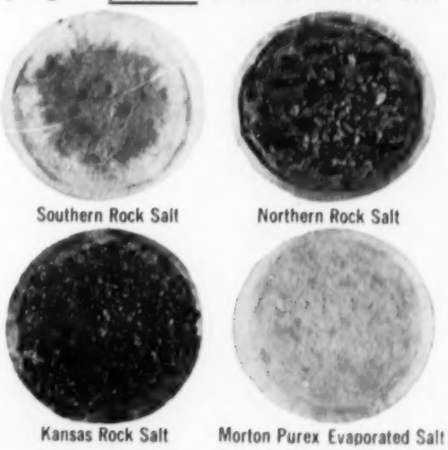

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